

Unit Construction Costs



FROM THE

New Smelter

OF THE

Arizona Copper Co., Ltd.

BY

E. HORTON JONES

FIRST EDITION

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INTRODUCTION

WE have endeavored in the following "sheets" to give the unit construction costs derived from the building of the Arizona Copper Co.'s new smelter, Clifton, Ariz., starting in February, 1912, and completing February, 1914.¹ In Chapter I—Unit Costs—are to be found the most elementary total unit costs which the accounts provide for. They are usable in the Clifton district. Here too are found the percentages to be added to an estimate for Engineering and General Expense. In Chapter II—Comparative Costs—these elementary costs have been classified, averaged and reported as labor and material unit costs. In such form the labor unit costs, when properly applied to similar conditions as those under which they were derived, are usable anywhere. The material unit costs are better disregarded for more accurate estimates and replaced by a newly priced bill of material. In Chapter III Composite Costs are given. They are unit costs built up from several elementary units, and likewise units of larger dimensions and simpler application, valuable for

¹ The smelter went into service producing copper October, 1913

checking estimates and obtaining quick approximations of total costs. In Chapters IV, V, and VI are given the Wage Scale, Material Prices, and a description of the conditions surrounding the making of every elementary unit cost, which will enable an estimator to judge of their use under any circumstance. It should be borne in mind that Chapter VI is not a pure description of the plant, nor of any of its parts, such as might be expected in a technical journal, but it is barely enough information for a reader to judge as to the applicability of a unit cost in another place.

These unit costs, as any examination will prove, are not ideal, but actual. They were made by a copper company organization extending over a period of two years. They represent delays in material shipments (serious delays in steel and brick deliveries), delayed plans, changes in plans, labor troubles, with changes in hours and rates, variable weather conditions, and the like. They do represent, however, every cent spent.

Each unit cost has been judged, as it stands, solely on its merits for use by an estimator. Where a unit cost is not given it was of no use, and where given and described, it must be employed accordingly.

During the first few months of construction work only the prime account numbers showing in the sheet were in use. Later, to obtain more accurate figures to measure the work by as it progressed, the decimal account numbers were added. But the decimal accounts were on record only in the engineering costing department at the new smelter, two miles from Clifton. The General Office, at Clifton, neglected all decimal accounts and charged them under the prime numbers. The labor segregation was in all instances made at the new smelter, and every charge for material, from whatever source, passed through the warehouse at the new smelter. The only other source of cost sheet entries was the General Office cash books. Once a month these entries were itemized and sent out in the monthly Cost Sheet issued by the General Office.

CHAPTER I

UNIT COSTS

The costs thus accrued from three sources. The individual labor card was not used until the excavating was well under way and the foundation work had started. Each man, who could, made out his card and told thereon exactly at what and how long he had been working. The labor bosses made out the cards for the Mexicans. The account number was later placed on the card by the time keeper and checked by a competent man in the engineering office. For every bit of material used on the job a requisition was passed through the warehouse, whether steel building or keg of nails. To this a charge number was attached and the requisition was finally checked by a competent man in the Engineering Department.

In regard to cash-book entries, there was little to be done, as all local bills were OK'd and account numbers attached by the Engineering Department in the first instance. The units were compiled by the Engineering Department daily as the work progressed and checked suitably.

Yet owing to the fact that the General Office kept the accounts segregated only under the prime account numbers, the slow development of the idea of making a final accurate unit cost sheet, the delay in using individual time cards and many clerical mistakes, it was finally thought best to check over every labor card and warehouse requisition from the beginning of the job. This was done and the unit costs as they now stand are believed to be accurate.

The making of this cost sheet is largely due to the untiring interest and insistent demand for accuracy upon the part of three members of the smelter construction force, G. H. Ruggles, M. Am. Soc. M. E.; Roy Earling, M. Am. Soc. M. E.; and H. F. Adams. Credit is due also to the ever willing assistance given by the Arizona Copper Co.'s general office, under the direction of J. G. Cooper, Cashier.

General Expense

| NUMBER | NAME OF ACCOUNT | TOTAL |
|--------|---------------------------------|---------------|
| 7001 | General expense at Clifton..... | See page 1581 |
| 7004 | Personal injuries..... | " " " |

Engineering

Engineering and Superintendence at Douglas

| | | |
|------|-----------------------------------|-------------|
| 7101 | Salaries..... | \$39,706.22 |
| 7103 | Telegraphing and telephoning..... | 167.55 |
| 7104 | Traveling expense..... | 1,984.85 |
| 7105 | Miscellaneous expense..... | 1,018.06 |
| | | <hr/> |
| | | \$42,876.68 |

Engineering and Superintendence at Clifton

| | | |
|--------|-----------------------------------|-------------------------------------|
| 7201 | Salaries..... | \$40,587.54 |
| 7202 | Furniture and fixtures..... | 149.43 |
| 7203 | Telegraphing and telephoning..... | 258.64 |
| 7204 | Traveling expense..... | 934.24 |
| 7205 | Miscellaneous supplies..... | 2,205.77 |
| 7206 | Miscellaneous labor..... | 869.02 |
| | | <hr/> |
| | | \$45,004.64 |
| 9000.1 | Power plant engineering..... | \$12,768.56 |
| | | <hr/> |
| 7100 | Total engineering expense..... | \$100,649.88 |
| | | Total unit cost..... 5.40 per cent. |

This percentage is obtained by dividing the engineering expense by the total cost of the smelter, minus engineering and indirect expense.

$$\frac{100,649.88}{1,864,092.47} = 5.40 \text{ per cent.}$$

7300.—Yard Tracks and Industrial System

Tracks

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|---------------------------------------|-------------|------------|-------------|----------------|-----------------|
| 7301 | Excavation..... | \$31,311.14 | \$4,254.86 | \$35,566.00 | 55,405 cu. yd. | \$0.64 |
| 7302 | Ties..... | 425.13 | 10,777.79 | 11,202.92 | 10,262 ties | 1.09 |
| 7303 | Rails and rail fastenings | 392.00 | 9,839.79 | 10,231.79 | 14,813 ft. | 0.69 |
| 7304 | Frogs and switches..... | 206.50 | 2,676.95 | 2,883.45 | 18 switches | 160.19 |
| 7305 | Laying, surfacing and ballasting..... | 5,873.53 | 248.88 | 6,122.41 | 17,150 ft. | 0.36 |

Trolley System

| | | | | | | |
|------|--------------------------|----------|----------|----------|-----------|-------|
| 7306 | Poles and setting..... | 1,427.27 | 1,804.73 | 3,232.00 | 106 poles | 30.49 |
| .1 | Brackets and wiring..... | 1,167.19 | 1,379.73 | 2,546.92 | 7,824 ft. | 0.33 |
| .2 | Rail bonds..... | 304.31 | 347.13 | 651.44 | 521 bonds | 1.25 |
| .3 | Lighting..... | 229.66 | 222.30 | 452.05 | 57 lamps | 7.93 |

Rolling Stock

| | | | | | | |
|------|-----------------------------------|--------|-----------|-----------|-------|-------|
| 7307 | Cars, elec. locomotives, etc..... | 801.29 | 34,017.63 | 34,818.92 | ..... | ..... |
| .1 | Calcine car alteration... | 381.02 | 4.36 | 385.38 | ..... | ..... |

Trestle Approach to Reverberatory Building

| | | | | | | |
|--------|----------------------|--------|----------|-----------|---------------|-------|
| 7308 | Excavation..... | 359.95 | ..... | 359.95 | 277 cu. yd. | 1.30 |
| 7308.1 | Foundations..... | 738.18 | 1,152.52 | 1,890.60 | 254.9 cu. yd. | 7.42 |
| .2 | Steel structure..... | ..... | ..... | 13,460.84 | 163.97 tons | 82.09 |
| .3 | Woodwork..... | 703.93 | 768.92 | 1,472.85 | 27.65 m.b.m. | 53.27 |

150-Ton Track Scales in Receiving Yard

| | | | | | | |
|------|------------------------|--------|----------|----------|-------------|-------|
| 7309 | Excavation..... | 348.91 | ..... | 348.91 | 388 cu. yd. | 0.90 |
| .1 | Foundation..... | 545.62 | 1,146.87 | 1,692.49 | 186 " | 9.10 |
| .11 | Cost and erection..... | 365.95 | 3,450.86 | 3,816.81 | 150 tons | 25.45 |
| .30 | Scale house..... | 65.66 | 63.87 | 129.53 | 879 cu. ft. | 0.15 |

Bridges, Culverts and Walls

| | | | | | | |
|------|----------------------------------|----------|----------|----------|---------------|--------|
| 7310 | Bridge No. 1 foundation. | 1,028.26 | 1,968.38 | 2,996.64 | 339.8 cu. yd. | 8.82 |
| .1 | " steel work.. | ..... | ..... | 377.40 | 3.70 tons | 102.00 |
| 7311 | Culvert No. 1 masonry.. | 1,384.85 | 695.80 | 2,080.65 | 354 lin. ft. | 5.88 |
| 7312 | Retaining walls excavation | 77.66 | ..... | 77.66 | 60 cu. yd. | 1.29 |
| .1 | " " concrete. | 512.34 | 734.25 | 1,246.59 | 203.5 " | 6.13 |
| .2 | " " masonry | 88.08 | 47.51 | 135.59 | 21.9 " | 6.19 |

40-Ton Track Scales on Calcine Track

| | | | | | | |
|------|------------------------|--------|--------|--------|-------------|-------|
| 7313 | Excavation..... | 108.44 | 0.51 | 108.95 | 118 cu. yd. | 0.92 |
| .1 | Foundation..... | 207.55 | 193.60 | 401.15 | 41.6 " | 9.64 |
| .2 | Cost and erection..... | 82.90 | 710.85 | 793.84 | 40 tons | 19.85 |
| .3 | Scale house..... | 100.38 | 88.21 | 188.59 | 879 cu. ft. | 0.22 |

Trestles to Receiving Bins

| | | | | | | |
|------|----------------------|----------|----------|----------|--------------|-------|
| 7314 | Excavation..... | 548.18 | ..... | 548.18 | 580 cu. yd. | 0.93 |
| .1 | Foundation..... | 2,408.16 | 3,017.95 | 5,426.11 | 754.3 " | 7.19 |
| .2 | Steel structure..... | ..... | ..... | 9,269.48 | 109.35 tons | 84.77 |
| .3 | Woodwork..... | 572.23 | 838.11 | 1,410.34 | 27.21 m.b.m. | 51.83 |

Total cost—Yard tracks and industrial system..... \$156,326.43

7400.—Receiving Bins

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT Cost |
|--------------------------------|----------------------|------------|----------|-------------|---------------|-----------------------|
| 7401 | Excavation..... | \$2,303.11 | \$39.16 | \$2,342.27 | 1,428 cu. yd. | \$1.64 |
| 7402 | Foundation..... | 1,235.51 | 2,247.70 | 3,483.21 | 612.3 " | 5.69 |
| 7403 | Steel structure..... | | | 20,276.63 | 353.09 tons | 82.92 |
| 7404 | Gates..... | 901.15 | 1,984.93 | 2,886.08 | 30 gates | 96.20 |
| 7405 | Conveyor No. 1..... | 310.92 | 2,947.19 | 3,258.11 | 97.3 ft. | 33.49 |
| .01 | Conveyor No. 2..... | 355.19 | 2,498.03 | 2,853.22 | 117.3 ft. | 24.33 |
| 7407 | Lighting..... | 60.87 | 24.67 | 85.54 | 22 drops | 3.89 |
| Total cost—Receiving bins..... | | | | \$44,185.06 | | |

7700.—Crushing Plant

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT Cost |
|--------------------------------|---|----------|------------|------------|---------------------|-----------------------|
| 7701 | Excavation..... | \$689.67 | | \$689.67 | 609 cu. yd. | \$1.13 |
| 7702 | Foundation..... | 893.15 | \$1,568.47 | 2,461.62 | 220.5 " | 11.16 |
| 7703 | Steel structure..... | | | 2,420.36 | 25.07 tons | 96.54 |
| .1 | Doors, windows and frames | 84.00 | 170.71 | 254.71 | 529 sq. ft. opening | 0.48 |
| .2 | Painting woodwork..... | 15.00 | 12.33 | 27.33 | 70 sq. yd. | 0.39 |
| 7704 | Crushing machinery..... | 392.86 | 1,093.61 | 1,486.47 | 500 cwt. | 2.97 |
| .1 | Chutes..... | 325.87 | 338.09 | 663.96 | 118.1 cwt. | 5.62 |
| 7705 | Shafting, pulleys and belt- ing..... | 4.17 | 483.35 | 487.52 | 12 lin. ft. | ..... |
| 7706 | Motor..... | 102.81 | 513.64 | 616.45 | 50 h.p. | 12.33 |
| 7707 | Power wiring..... | 26.55 | 19.35 | 45.90 | ..... | ..... |
| .1 | Lighting..... | 76.41 | 38.22 | 114.63 | 8 drops | 14.33 |
| Total cost—Crushing plant..... | | | | \$9,268.62 | | |

7800.—Sampling Plant

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT Cost |
|--------------------------------|--|----------|----------|-------------|-----------------------|-----------------------|
| 7801 | Excavation..... | \$274.09 | \$20.97 | \$295.06 | 332 cu. yd. | \$0.89 |
| 7802 | Foundation..... | 605.91 | 649.44 | 1,255.35 | 120.7 " | 10.40 |
| .1 | Concrete ground floor... | 105.68 | 263.92 | 369.60 | 1,222 sq. ft. | 0.30 |
| .2 | Reinforced concrete floors | 1,050.61 | 1,080.30 | 2,130.91 | 4,244 " | 0.50 |
| 7803 | Steel structure..... | | | 10,408.12 | 110.85 tons | 93.89 |
| .1 | Doors, windows and frames..... | 332.94 | 564.90 | 897.84 | 2,086 sq. ft. opening | 0.43 |
| .11 | Painting doors and win- dows..... | 118.94 | 28.96 | 147.90 | 129 sash | 1.15 |
| 7804 | Shafting, pulleys and belting..... | 64.01 | 1,871.07 | 1,935.08 | 85 ft. of shafting | 22.76 |
| 7805 | Meters..... | 186.76 | 887.57 | 1,074.33 | 90 h.p. | 11.94 |
| 7806 | Power wiring..... | 78.11 | 120.55 | 198.66 | ..... | ..... |
| .1 | Lighting..... | 184.45 | 140.57 | 325.02 | 36 drops | 9.03 |
| 7807 | Rolls and samplers, cost and erection..... | 1,215.83 | 7,899.14 | 9,114.97 | 1,251.1 cwt. | 7.29 |
| .1 | Cast iron liners and dry- ing pan, and erection of chutes..... | 1,240.69 | 1,001.80 | 2,242.55 | 270.6 cwt. | 8.29 |
| .20 | Elevator..... | 20.39 | 458.22 | 478.61 | 1 elevator | 478.61 |
| .50 | Steel chutes (made at new smelter)..... | 1,995.70 | 596.65 | 2,592.35 | 198 cwt. | 13.09 |
| 7809 | Keystone plate partitions | 131.04 | 338.32 | 469.36 | 1,523 sq. ft. | 0.31 |
| 7810 | Alterations of chutes and machinery..... | 128.69 | 44.34 | 173.03 | ..... | ..... |
| Total cost—Sampling plant..... | | | | \$34,108.74 | | |

7900.—Bedding Plant and Bunker Bins

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|---|--|-------------|-----------|--------------|----------------|-----------------------|
| 7901 | Excavation..... | \$11,577.53 | \$681.90 | \$12,259.43 | 12,319 cu. yd. | \$0.99 |
| 7902 | Foundation..... | 6,256.34 | 14,513.21 | 20,769.55 | 2,809.7 " | 7.39 |
| 7903 | Steel structure..... | | | 47,404.86 | 548.71 tons | 86.39 |
| 7904 | Conveyors 7-7 ² | 564.34 | 6,373.67 | 6,938.01 | 380.2 ft. | 18.24 |
| .1 | " 8-8 ² -8 ³ | 1,211.01 | 8,718.98 | 9,929.99 | 562 ft. | 17.67 |
| .2 | " 9-9 ² -9 ³ - 10-10 ² | 1,912.20 | 9,756.19 | 11,668.39 | 905.5 ft. | 12.88 |
| .3 | Bunker bin gates.... | 161.58 | 1,021.64 | 1,183.22 | 42 gates | 28.17 |
| .4 | Chutes for conveyors 7 ² to 10 ² inc..... | 658.91 | 842.60 | 1,501.51 | 276.2 cwt. | 5.44 |
| 7905 | Two reclaimers..... | 3,103.28 | 30,579.45 | 33,682.73 | 2 reclaimers | 16,841.37 |
| .1 | " wiring..... | 377.21 | 131.19 | 508.40 | 2 " | 254.20 |
| 7906 | Lighting..... | 306.85 | 127.38 | 434.23 | 63 drops | 6.89 |
| 7907 | Transfer car..... | 739.12 | 3,823.19 | 4,562.31 | 1 car | 4,562.31 |
| 7908 | Signal system..... | 67.68 | 28.74 | 96.42 | | |
| Total cost—Bedding plant and bunker bins..... | | | | \$160,939.05 | | |

8100.—Roasting Plant

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------------------------------|--|------------|-----------|--------------|-----------------|-----------------------|
| 8101 | Excavation..... | \$1,547.07 | | \$1,547.07 | 1,216 cu. yd. | \$1.27 |
| 8102 | Foundation..... | 765.42 | 1,069.63 | 1,835.05 | 250.5 " | 7.33 |
| 8103 | Steel structure..... | | | 37,252.67 | 445.28 tons | 83.66 |
| .1 | Elevator..... | | | 2,189.62 | 5 tons capacity | 437.92 |
| 8104 | Roasters, cost and erection..... | 3,716.94 | 56,326.09 | 60,043.03 | 8 roasters | 7,505.38 |
| .1 | " alterations... brickwork.... | 620.49 | 81.69 | 702.18 | 10 spouts..... | |
| 8105 | " " unloading | 4,730.85 | 12,336.35 | 17,067.20 | 16,104 cu. ft. | 1.06 |
| .01 | " " brick..... | 363.14 | | 363.14 | 1,231.01 tons | 0.29 |
| .02 | " " centering for brickwork.... | 1,389.62 | 588.25 | 1,977.87 | 8 roasters | 247.23 |
| 8106.01 | Roaster flue, spouts.... | 116.52 | 568.99 | 685.51 | 10 spouts | 68.55 |
| .02 | " " tile work.. | 374.82 | 400.36 | 775.18 | 2,365 cu. ft. | 0.33 |
| .03 | " " painting inside..... | 8.50 | 3.97 | 12.47 | 73 sq. yd. | 0.17 |
| 8107 | Shafting, pulleys and belting..... | 118.24 | 1,999.89 | 2,118.13 | 164 lin. ft. | 12.92 |
| 8108 | Motor..... | 277.08 | 463.96 | 741.04 | 30 h.p. | 24.70 |
| 8109 | Lighting..... | 340.64 | 157.70 | 498.34 | 67 drops | 7.44 |
| 8112 | Motor-driven fans.... | 77.69 | 1,405.91 | 1,483.60 | 2 fans | 741.80 |
| 8112.1 | Blast pipe from fans to roaster..... | 1,569.62 | 656.62 | 2,226.24 | 240 ft. | 9.28 |
| 8113 | Conveyor No. 12..... | 164.15 | 805.05 | 969.20 | 51.2 ft. | 18.93 |
| .1 | " 13 ¹ and 13 ² .. | 476.29 | 3,472.23 | 3,948.62 | 217.3 ft. | 18.17 |
| .2 | Stile over conveyors.... | 98.91 | 199.80 | 298.71 | 2.40 tons | 124.46 |
| Total cost—Roasting plant..... | | | | \$136,734.87 | | |

8120.—Roaster Dust Chamber

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------------------------------------|-----------------------|----------|----------|-------------|----------------|-----------------------|
| 8121 | Excavation..... | \$918.74 | \$194.09 | \$1,112.83 | 1,194 cu. yd. | \$0.93 |
| 8122 | Foundation..... | 1,049.71 | 1,775.05 | 2,824.76 | 472.9 " | 5.97 |
| 8123 | Steel structure..... | | | 34,745.41 | 415.68 tons | 83.59 |
| .01 | Wire baffles..... | 523.63 | 4,758.23 | 5,281.86 | 604.8 c. wires | 8.73 |
| .1 | Tile work..... | 2,268.29 | 2,585.45 | 4,853.74 | 14,980 cu. ft. | 0.33 |
| .11 | Unloading tile..... | 307.72 | | 307.72 | 525.05 tons | 0.59 |
| .2 | Painting outside..... | 304.75 | 115.82 | 420.57 | 2,851 sq. yd. | 0.15 |
| .3 | Painting inside..... | 93.50 | 24.37 | 117.87 | 950 " | 0.12 |
| Total cost—Roaster dust chamber..... | | | | \$49,664.76 | | |

8300.—Reverberatory Plant

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|---|------------|-----------|------------|-----------------------------|-----------------------|
| 8301 | Excavation..... | \$1,417.88 | \$59.78 | \$1,477.66 | 1,890 cu. yd. | \$0.78 |
| .01 | Back filling..... | 2,742.44 | 13.11 | 2,755.55 | 3,679 " | 0.75 |
| 8302 | Foundation..... | 7,715.96 | 15,044.09 | 22,760.05 | 2,810 " | 8.10 |
| .1 | Concrete counterweights. | 88.22 | 79.27 | 167.49 | 8.5 " | 19.71 |
| 8303 | Steel structure..... | ..... | ..... | 40,799.76 | 461.09 tons | 88.48 |
| 8304 | Reverberatories, brickwork | 8,402.75 | 34,963.88 | 43,366.63 | 29,680 cu. ft. | 1.46 |
| .01 | " unloading brick.... | 934.78 | 329.71 | 1,264.49 | 2,279.49 tons | 0.55 |
| .02 | " centering..... | 859.77 | 547.78 | 1,407.55 | 3 reverbera- tories..... | 469.18 |
| .05 | " rehandling brick.... | 1,503.85 | ..... | 1,503.85 | 1,530.92 tons | 0.98 |
| .1 | " steel work..... | 1,366.38 | 14,552.71 | 15,919.09 | 240 tons | 66.33 |
| .2 | " silica fill..... | 3,715.66 | 5,689.41 | 9,405.07 | 1,231.49 tons | 7.64 |
| .3 | " hoppers and chutes. | 150.08 | 1,263.59 | 1,413.67 | 403.35 cwt. | 3.51 |
| 8305 | Cross and header flues, brickwork..... | 3,296.65 | 15,098.97 | 18,395.62 | 18,500 cu. ft. | 0.99 |
| .01 | " unloading brick.... | 403.77 | 93.83 | 497.60 | 1,329.23 tons | 0.37 |
| .02 | " centering..... | 316.84 | 125.97 | 442.81 | 3 sets | 147.60 |
| .2 | " painting brick..... | 46.88 | 21.45 | 68.33 | 473 sq. yd. | 0.15 |
| 8306 | Flues from boilers to re- verberatory, flue ex- cavation..... | 19.86 | ..... | 19.86 | 15 cu. yd. | 1.32 |
| .1 | " foundation..... | 74.22 | 74.02 | 148.24 | 0.2 " | 16.11 |
| .2 | " steel structure..... | ..... | ..... | 2,815.32 | 34.78 tons | 80.95 |
| 8307 | Reverb. boiler bldg. exca'n | 283.14 | ..... | 283.14 | 306 cu. yd. | 0.93 |
| .01 | Waste heat boilers " | 213.44 | ..... | 213.44 | 129 " | 1.65 |
| .02 | Oil-fired boilers " | 73.60 | ..... | 73.60 | 97 " | 0.76 |
| .03 | Boiler feed pumps " | 591.28 | 10.16 | 601.44 | 659 " | 0.91 |
| .04 | Backfill, back of boiler wall | 518.10 | 30.00 | 548.10 | 972 " | 0.56 |
| .1 | Boiler building foundations | 2,181.08 | 3,846.18 | 6,027.26 | 573.7 " | 10.51 |
| .11 | Waste heat boilers " | 789.52 | 793.97 | 1,583.49 | 138.7 " | 11.42 |
| .12 | Oil-fired boilers " | 350.45 | 686.29 | 1,036.74 | 100 " | 10.37 |
| .13 | Feed pumps foundation.... | 678.73 | 1,428.97 | 2,107.70 | 214.7 " | 9.82 |
| .2 | Floor over slag track cut.. | 1,018.17 | 1,687.29 | 2,705.46 | 7,676 sq. ft. | 0.35 |
| .3 | Floor around boilers..... | 276.29 | 664.82 | 941.11 | 2,705 " | 0.35 |
| 8308 | Boiler building, steel struc- ture..... | ..... | ..... | 25,839.85 | 202.03 tons | 88.48 |
| .5 | Platform and brackets.... | 1,317.18 | 2,556.45 | 3,873.63 | 29.50 tons | 131.30 |
| 8309 | Waste heat boilers, inc. all steel..... | 4,078.19 | 30,335.30 | 42,413.49 | 7 boilers | 6,059.07 |
| .01 | " " brickwork..... | 3,878.57 | 13,749.97 | 17,628.54 | 18,025 cu. ft. | 0.98 |
| .02 | " " unloading brick..... | 510.74 | 8.17 | 518.91 | 1,073.74 tons | 0.48 |
| .03 | " " painting..... | 140.53 | 84.29 | 224.82 | 1,190 sq. yd. | 0.19 |
| .05 | " " rehandling .. brick..... | 185.76 | ..... | 185.76 | 1,135.57 tons | 0.16 |
| .1 | Oil fired boilers, inc. all steel..... | 1,892.22 | 13,125.78 | 15,018.00 | 3 boilers | 5,006.00 |
| .11 | " " brickwgrk..... | 1,697.31 | 1,154.62 | 2,851.93 | 6,561 cu. ft. | 0.43 |
| .12 | " " unloading brick.. | 168.44 | 15.50 | 183.94 | 228.11 tons | 0.81 |
| .13 | " " painting..... | 124.59 | 24.16 | 148.75 | 438 sq. yd. | 0.34 |
| .15 | " " rehandling brick. | 137.06 | ..... | 137.06 | 413.35 tons | 0.33 |
| 8310 | Superheaters waste heat boilers..... | 654.41 | 8,288.71 | 8,943.12 | 7 heaters | 1,277.58 |
| .1 | " oil fired boilers..... | 280.28 | 2,756.41 | 3,036.69 | 3 boilers | 1,012.23 |
| 8312 | Misc. piping boilers and reverb. bldg..... | 524.15 | 1,409.85 | 1,934.00 | ..... | ..... |
| .1 | Feed piping from heating plant to feed pumps..... | 1,039.91 | 51.51 | 1,091.42 | 1,296 cu. yd. | 0.84 |
| .11 | " " from conduit and pipe.... | 386.25 | 2,757.79 | 3,144.04 | 557 ft. | 5.64 |

8300.—Reverberatory Plant (Continued)

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--|---|----------|----------|--------------|------------|-----------------------|
| 8312.20 | " " from pumps to boilers..... | 1,060.53 | 3,041.00 | 4,101.53 | 1,093 ft. | 3.75 |
| .50 | Blow-off piping and drum. | 145.32 | 527.77 | 673.09 | ..... | ..... |
| 8313 | Wiring electrical feed pumps..... | 135.45 | 177.89 | 313.34 | 2 pumps | 156.67 |
| .1 | Lighting for reverb. and boiler bldg..... | 612.30 | 473.19 | 1,085.49 | 104 drops | 10.45 |
| 8314 | Slag launders..... | 433.20 | 1,157.80 | 1,591.00 | 72 ft. | 22.10 |
| 8315 | Matte launders..... | 142.66 | 1,209.08 | 1,351.74 | 304 ft. | 4.44 |
| 8316 | Six No. 14 Wilgus oil systems..... | 111.48 | 1,862.29 | 1,973.77 | 6 pumps | 328.96 |
| 8317 | Two electrical feed pumps. | 240.25 | 5,633.97 | 5,874.22 | 2 " | 2,937.11 |
| .1 | One steam feed pump.... | 37.27 | 499.24 | 536.51 | 1 " | 536.51 |
| .2 | Crawls and chain block in feed pump house..... | 2.00 | 112.05 | 114.05 | ..... | ..... |
| 8318 | Fettling system | 1,463.13 | 1,943.08 | 3,406.21 | 3 furnaces | 1,135.40 |
| Total cost—Reverberatory plant..... | | | | \$328,945.02 | | |

8400.—Converter Plant

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|--|----------|-----------|-----------|---------------|-----------------------|
| 8401 | Excavation..... | 5,163.74 | 567.37 | 5,731.11 | 6,330 cu. yd. | 0.91 |
| 8402 | Foundation..... | 1,796.56 | 2,860.16 | 4,656.72 | 776.9 cu. yd. | 6.00 |
| 8403 | Steel structure..... | ..... | ..... | 69,359.60 | 783.86 tons | 88.48 |
| 8404 | Converter stands—Exca- vation..... | 255.48 | 3.40 | 258.88 | 304 cu. yd. | 0.85 |
| .1 | " " —foun- dation..... | 555.53 | 1,331.03 | 1,886.56 | 173.8 cu. yd. | 10.85 |
| 8405 | " " and shells | 821.67 | 22,238.28 | 23,059.95 | 162.53 tons | 141.88 |
| .01 | Repairs to No. 2 stand... | 164.44 | 9.53 | 173.97 | ..... | ..... |
| .1 | Converter shells—brick lining.. | 785.61 | 8,043.00 | 8,828.61 | 4 shells | 2,207.15 |
| .11 | " " —unload- ing brick. | 104.22 | 82.03 | 186.25 | 579.30 tons | 0.32 |
| 8406 | Cranes..... | 1,438.50 | 23,027.65 | 24,466.15 | 110.75 tons | 220.91 |
| .1 | " wiring..... | 1,941.44 | 342.62 | 2,284.06 | 2 cranes | 1,142.03 |
| 8407 | Clinkering machines..... | 1,715.23 | 13,981.94 | 15,698.17 | 2 machines | 7,640.71 |
| .01 | " " altera- tion No. 1 | 33.00 | 1.43 | 34.43 | ..... | ..... |
| .02 | " " altera- tion No. 2. | 57.92 | 40.39 | 98.31 | ..... | ..... |
| .03 | Clinkering machine electri- cal alteration..... | 65.98 | 31.10 | 97.08 | ..... | ..... |
| .1 | Clinkering machines, wiring..... | 392.21 | 283.79 | 676.00 | 2 machines | 338.00 |
| 8409 | Wiring for converter con- trol..... | 136.42 | 318.49 | 454.91 | 3 converters | 151.64 |
| .1 | Lighting..... | 451.93 | 462.01 | 913.94 | 60 drops | 15.23 |
| 8410 | Air pipe from power house excav..... | 224.06 | ..... | 224.06 | 331 cu. yd. | 0.68 |
| .1 | Air pipe from power house laying..... | 674.62 | 2,041.89 | 2,716.51 | 422 ft. | 6.43 |
| 8411 | Ladles, boats, bales, tools, etc..... | 906.82 | 4,932.39 | 5,839.21 | ..... | ..... |

8400.—Converter Plant (Continued)

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|---|----------|-----------|--------------|---------------|-----------------|
| S413 | Casting machine excavation... | 490.39 | 30.43 | 520.82 | 512 cu. yd. | 1.02 |
| S414 | " " foundation... | 1,627.37 | 1,889.36 | 3,516.73 | 291.9 cu. yd. | 12.05 |
| S415 | " " cost and erection. | 3,266.34 | 24,211.21 | 27,477.55 | 2 machines | 13,738.7 |
| .1 | " " repairs.. | 221.71 | 13.88 | 235.59 | ..... | ..... |
| S416 | Loading platform excavation. | 212.49 | .28 | 212.77 | 216 cu. yd. | 0.99 |
| .1 | " " foundation... | 311.35 | 505.68 | 817.03 | 93.2 cu. yd. | 8.77 |
| .11 | " " floors... | 381.02 | 1,053.55 | 1,434.57 | 6,803 sq. ft. | 0.21 |
| .2 | " " backfill. | 67.85 | ..... | 67.85 | 129 cu. yd. | 0.53 |
| .3 | " " striking plates.. | 53.09 | 126.60 | 179.78 | 119 sq. ft. | 1.51 |
| S417 | Hoods and smoke boxes.. | 2,674.30 | 4,012.59 | 6,686.89 | 3 sets | 2,228.96 |
| .1 | Hood to protect converter operator..... | 62.67 | 109.66 | 172.33 | 1 hood | 172.33 |
| S418 | Spouts, gates and hoppers at Silica ore bins..... | 245.48 | 1,400.37 | 1,645.85 | ..... | ..... |
| S419.1 | 10-ton bullion scales excavation..... | 19.76 | ..... | 19.76 | 24 cu. yd. | 0.82 |
| .2 | " " " | 58.32 | 65.19 | 123.51 | 10.5 cu. yd. | 11.70 |
| .3 | " " " foundation..... | 55.55 | 736.53 | 792.08 | 10 tons | 79.21 |
| .4 | " " " cost and erection..... | 48.78 | 41.09 | 89.87 | 1 shed | 89.87 |
| S425 | Conveyor No. 15..... | 422.77 | 2,251.47 | 2,674.24 | 165 ft. | 16.21 |
| S426.1 | Wet pan excavation..... | 2.44 | ..... | 2.44 | 3 cu. yd. | 0.81 |
| .2 | " " foundation..... | 53.30 | 55.96 | 109.26 | 7.5 cu. yd. | 14.57 |
| .3 | " " cost and erection. | 301.76 | 1,050.10 | 1,354.86 | 1 pan | 1,354.86 |
| .4 | " " bin and spout... | 75.64 | 180.47 | 256.11 | 548 cwt. | 4.07 |
| | Total cost converter plant ..... | ..... | ..... | \$216,033.37 | ..... | ..... |

8420. ^{DIFFERENCE} Converter Dust Chamber

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--|---------------------------|----------|----------|-------------|----------------|-----------------------|
| 8421 | Excavation..... | \$127.28 | ..... | \$127.28 | 265 cu. yd. | \$0.48 |
| 8422 | Foundation..... | 668.85 | 1239.17 | 1,908.02 | 286.4 cu. yd. | 6.66 |
| 8423 ¹ | Steel structure..... | ..... | ..... | 20,371.20 | 238.30 tons | 85.49 |
| .01 | Wire baffles..... | 138.86 | 1,101.95 | 1,240.81 | 166.10 c. wire | 7.47 |
| .1 | Tile work..... | 1,620.05 | 2,182.40 | 3,802.45 | 6,369 cu. ft. | 0.60 |
| .11 | Tile handling..... | 37.61 | ..... | 37.61 | 155.20 tons | 0.24 |
| 8424 | Iron doors and frames.... | 1.94 | 158.93 | 160.87 | ..... | ..... |
| 8428 | Smoke box track..... | 155.32 | 10.02 | 165.34 | ..... | ..... |
| Total cost converter dust chamber..... | | | | \$27,813.58 | ..... | ..... |

8500.—Conveying System

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|---------------------------------------|---------------------------------------|------------|-----------|-------------|---------------------|-----------------------|
| 8501 | Excavation..... | \$1,824.22 | ..... | 1,824.22 | 2,286 cu. yd. | \$0.80 |
| 8502 | Foundation..... | 2,550.78 | 4,006.37 | 6,557.15 | 622.3 cu. yd. | 10.54 |
| 8503 | Steel structure..... | ..... | ..... | 19,365.98 | 211.73 tons | 91.47 |
| 8504 | Woodwork..... | 589.51 | 630.42 | 1,219.93 | 13.86 m.b.m. | 88.02 |
| .1 | Floor battens..... | 146.29 | 51.47 | 197.76 | ..... | ..... |
| 8505 | Conveyors No.'s 3-4-5-6 11-14..... | 1,210.87 | 12,505.62 | 13,716.49 | 1,284.9 ft. | 10.68 |
| .1 | Chutes..... | 665.15 | 167.13 | 832.28 | 23.3 cwt. | 3.67 |
| .2 | Guides..... | 28.00 | ..... | 28.00 | ..... | ..... |
| .3 | Weightometer..... | 65.00 | 1,329.92 | 1,394.92 | 1 weighto- meter | 1,994.92 |
| 8506 | Lighting..... | 189.86 | 84.56 | 274.42 | 33 drops | 8.32 |
| Total cost—Conveying sys- tem..... |  | ..... | ..... | \$4,5411.15 | ..... | ..... |

8600.—Chimney

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|-------------------------|-----------------|----------|-----------|-------------|----------------|-----------------------|
| 8601 | Excavation..... | \$337.44 | \$29.61 | \$367.05 | 597 cu. yd. | \$0.61 |
| 8602 | Foundation..... | 654.42 | 4,199.65 | 4,854.07 | 872.7 cu. yd. | 5.56 |
| 8603 | Brickwork..... | 891.88 | 39,358.34 | 40,250.22 | 58,644 cu. ft. | 0.69 |
| Total cost chimney..... |  | ..... | ..... | \$45,471.34 | ..... | ..... |

8610.—Reverberatory Flue

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|---------------------------------------|----------------------|----------|----------|-------------|---------------|-----------------------|
| 8611 | Excavation..... | \$916.72 | \$20.21 | \$936.93 | 1,588 cu. yd. | \$0.59 |
| 8612 | Foundation..... | 1,657.09 | 3,886.80 | 5,543.89 | 487.8 cu. yd. | 11.37 |
| 8613 | Brickwork..... | 1,272.86 | 1,696.39 | 2,969.25 | 6,400 cu. ft. | 0.46 |
| .01 | Unloading brick..... | 57.79 | ..... | 57.79 | 278.33 tons | 0.21 |
| 8614 | Steel structure..... | ..... | ..... | 3,593.06 | 41.61 tons | 86.35 |
| .1 | Clean out doors..... | 10.61 | 153.61 | 164.22 | ..... | ..... |
| .2 | Caulking roof..... | 184.35 | 4.21 | 188.56 | ..... | ..... |
| Total cost—Reverberatory flue..... |  | ..... | ..... | \$13,453.70 | ..... | ..... |

8620.—Converter Flue

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|---------------------------|----------------------|----------|----------|------------|-------------|-----------------------|
| 8621 | Excavation..... | \$168.02 | ..... | \$168.02 | 198 cu. yd. | \$0.85 |
| 8622 | Foundation..... | 165.73 | 652.69 | 818.42 | 142 cu. yd. | 5.76 |
| 8624 | Steel structure..... | ..... | ..... | 6,616.44 | 81.99 tons | 80.70 |
| Total cost—Converter flue |  | ..... | ..... | \$7,602.88 | ..... | ..... |

8625.—Roaster Dust Chamber Flue

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--|----------------------|----------|----------|-------------|---------------|-----------------------|
| 8626 | Excavation..... | \$225.37 | ..... | \$225.37 | 213 cu. yd. | \$1.06 |
| 8627 | Foundation..... | 224.35 | 551.23 | 775.58 | 114.6 cu. yd. | 6.77 |
| 8628 | Brickwork..... | 1,018.13 | 1,573.06 | 2,591.19 | 4,231 cu. ft. | 0.61 |
| .01 | Unloading brick..... | 57.60 | ..... | 57.60 | 171.40 tons | 0.34 |
| 8629 | Steel structure..... | ..... | ..... | 9,209.36 | 94.46 tons | 97.49 |
| Total cost—Roaster dust chamber flue..... |  | ..... | ..... | \$12,859.10 | ..... | ..... |

8700.—Boiler and Blacksmith Shop

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--|--------------------------------------|------------|----------|-------------|-----------------------|-----------------------|
| 8701 | Excavation..... | \$1,142.07 | \$44.81 | \$1,186.88 | 1,458 cu. yd. | \$0.81 |
| 8702 | Foundation..... | 416.57 | 584.49 | 1,001.06 | 78.7 cu. yd. | 12.71 |
| 8703 | Steel structure..... | | | 2,913.90 | 32.72 tons | 89.06 |
| .1 | Doors, windows and frames..... | 693.02 | 2,456.28 | 3,149.30 | 2,581 sq. ft. opening | 1.22 |
| .11 | Concrete sills..... | 119.80 | 50.87 | 170.67 | 251.5 lin. ft. | 0.68 |
| .2 | Tile walls..... | 477.95 | 612.62 | 1,090.57 | 2,297 cu. ft. | 0.48 |
| .21 | Unloading tile..... | 18.89 | | 18.89 | 69.70 tons | 0.27 |
| .22 | Coping..... | 112.17 | 2.72 | 114.89 | 290 lin. ft. | 0.40 |
| .30 | Roof..... | 286.52 | 828.24 | 1,114.76 | 66.49 squares | 16.77 |
| 8703.31 | Ventilators..... | 16.01 | 261.50 | 277.51 | 3 vents | 92.50 |
| .40 | Dirt floor..... | 59.73 | 1.25 | 60.98 | | |
| .50 | Benches..... | 87.83 | 49.43 | 137.26 | | |
| .60 | Painting..... | 92.53 | 60.73 | 153.26 | 1,574 sq. yd. | 0.10 |
| 8704 | Crane..... | 119.60 | 438.41 | 558.01 | 1 crane | 558.01 |
| 8705 | Tools..... | 798.51 | 7,859.36 | 8,655.87 | | |
| 8706 | Shafting, pulleys, belt- ing..... | 105.59 | 301.16 | 406.75 | 51 lin. ft. | 7.98 |
| 8707 | Motor..... | 23.22 | 347.54 | 370.76 | 20 h.p. | 18.54 |
| 8708 | Lighting..... | 23.41 | 44.50 | 67.91 | 17 drops | 4.00 |
| Total cost—Boiler and blacksmith shop..... | | | | \$21,440.23 | | |

8714.—Machine and Carpenter Shop

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--|---------------------------------------|------------|----------|-------------|-----------------------|-----------------------|
| 8715 | Excavation..... | \$1,615.83 | \$325.28 | \$1,941.11 | 1,765 cu. yd. | \$1.10 |
| 8716 | Foundation..... | 792.05 | 584.06 | 1,376.11 | 105.5 cu. yd. | 13.04 |
| 8717 | Steel structure..... | | | 3,431.42 | 38.23 tons | 89.76 |
| .1 | Doors, windows and frames..... | 923.61 | 2,992.16 | 3,915.77 | 3,037 sq. ft. opening | 1.29 |
| .11 | Concrete sills..... | 111.65 | 67.70 | 179.35 | 295.3 lin' ft. | 0.61 |
| .2 | Tile walls..... | 531.45 | 571.28 | 1,102.73 | 2,397 cu. ft. | 0.46 |
| .21 | Unloading tile..... | 42.06 | 2.00 | 44.06 | 58.80 tons | 0.75 |
| .22 | Wall coping..... | 121.67 | 23.70 | 145.37 | 320 lin. ft. | 0.45 |
| .30 | Roof..... | 297.85 | 953.04 | 1,250.89 | 77.21 squares | 16.20 |
| .31 | Ventilators..... | 11.16 | 248.24 | 259.40 | 3 ventilators | 86.45 |
| .40 | Floor..... | 269.80 | 593.30 | 863.10 | 4,136 sq. ft. | 0.21 |
| .50 | Benches..... | 130.00 | 35.00 | 165.00 | | |
| .60 | Painting..... | 118.00 | 87.40 | 205.40 | 1,980 sq. yd. | 0.10 |
| 8718 | Crane..... | 25.19 | 564.36 | 589.55 | | |
| 8719 | Tools..... | 444.07 | 8,953.13 | 9,397.20 | | |
| 8720 | Shafting, pulleys and belting..... | 289.29 | 1,513.36 | 1,802.65 | 152 lin. ft. | 11.86 |
| 8721 | Motor..... | 18.34 | 477.97 | 496.31 | 40 h.p. | 12.40 |
| 8722 | Lighting..... | 55.84 | 135.01 | 190.85 | 20 drops | 9.54 |
| Total cost—Machine and carpenter shop..... | | | | \$27,356.27 | | |

8800.—General Office

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|--------------------------|-------|------------|------------|----------|-----------------------|
| 8804 | Furniture and fixtures.. | | \$1,394.95 | \$1,394.95 | | |

8809.—Warehouse

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|---------------------------|----------|----------|----------|-----------------------|-----------------------|
| 8810 | Excavation..... | \$944.59 | \$51.49 | \$996.08 | 1,287 cu. yd. | \$0.77 |
| 8811 | Foundation..... | 878.16 | 856.09 | 1,734.25 | 123 cu. yd. | 14.09 |
| 8812 | Steel structure..... | | | 3,734.08 | 39.76 tons | 93.92 |
| .1 | Doors, windows and frames | 533.02 | 1,056.31 | 1,589.33 | 1,982 sq. ft. opening | 0.80 |
| .11 | Concrete sills..... | 164.72 | 61.63 | 226.35 | 241.5 lin. ft. | 0.94 |
| .2 | Tile walls..... | 438.00 | 477.86 | 915.86 | 2,342 cu. ft. | 0.39 |
| .21 | Unloading tile..... | 15.50 | 1.00 | 16.50 | 74.20 tons | 0.22 |
| .22 | Coping..... | 176.60 | 36.53 | 213.13 | 320 lin. ft. | 0.67 |
| .3 | Painting roof..... | 81.16 | 65.66 | 146.82 | 813 sq. ft. | 0.18 |
| .31 | Ventilators..... | 30.38 | 207.12 | 237.50 | 3 vents | 79.17 |
| .4 | Floor excavation..... | 129.03 | | 129.03 | 66 cu. yd. | 1.96 |
| .41 | " concrete..... | 558.04 | 721.60 | 1,279.64 | 8,298 sq. ft. | 0.15 |
| .5 | Lighting..... | 45.09 | 70.48 | 115.57 | 26 drops | 4.45 |
| 8813 | Warehouse fixtures..... | 548.66 | 1,541.12 | 2,089.78 | | |
| .1 | Painting..... | 26.50 | 14.17 | 40.67 | 412 sq. yd. | 0.10 |
| .11 | " sash..... | 122.78 | 15.34 | 138.12 | 189 sash | 0.73 |

Total cost—Warehouse..... \$13,602.71

8819.—Laboratory

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|-------------------------------|----------|----------|----------|---------------------|-----------------------|
| 8820 | Excavation..... | \$191.11 | \$0.16 | \$191.27 | 212 cu. yd. | \$0.90 |
| 8821 | Foundation..... | 448.42 | 575.13 | 1,023.55 | 96.5 cu. yd. | 10.61 |
| .1 | Plain concrete floors..... | 113.78 | 154.90 | 268.68 | 1,026 sq. ft. | 0.26 |
| .2 | Reinforced floors..... | 59.81 | 114.87 | 174.68 | 364 sq. ft. | 0.48 |
| .3 | Sills and lintels..... | 109.53 | 22.85 | 132.38 | 163 lin. ft. | 0.81 |
| 8822 | Tile walls..... | 250.71 | 517.66 | 768.37 | 841 cu. ft. | 0.91 |
| .2 | Carpenter work..... | 194.43 | 338.16 | 532.59 | | |
| .5 | Doors, windows and skylights. | 208.70 | 480.33 | 689.03 | 823 sq. ft. opening | 0.84 |
| 8824 | Wood fixtures..... | 486.90 | 204.02 | 690.92 | | |
| 8825 | Lighting..... | 226.77 | 61.28 | 288.05 | | |
| 8826 | Plumbing..... | 129.79 | 97.23 | 227.02 | | |
| 8828 | Painting..... | 151.46 | 55.05 | 206.51 | | |
| 8829 | Plastering..... | 58.11 | 30.55 | 88.66 | 171.5 sq. yd. | 0.52 |
| 8830 | Apparatus..... | 44.82 | 618.98 | 663.80 | | |
| 8831 | Air centrifuge..... | 40.92 | 157.59 | 198.51 | | |

Total cost—Laboratory..... \$6,144.02

8840.—Sample Room

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|--|---------|----------|---------|---------------------|-----------------------|
| 8841 | Excavation..... | \$61.35 | | \$61.35 | 72 cu. yd. | \$0.85 |
| 8842 | Foundation..... | 61.00 | 64.43 | 125.43 | 9 cu. yd. | 13.94 |
| .1 | Concrete floors..... | 63.17 | 75.25 | 138.42 | 489 sq. ft. | 0.28 |
| 8843 | Walls and roof structure..... | 101.84 | 201.81 | 303.65 | | |
| .4 | Roof..... | 23.00 | 76.57 | 99.57 | 8 squares | 12.45 |
| .5 | Doors and windows..... | 32.39 | 118.85 | 151.24 | 298 sq. ft. opening | 0.51 |
| 8844 | Oven..... | 233.74 | 58.56 | 292.30 | | |
| 8845 | Benches, motor platform and fixtures..... | 128.35 | 129.60 | 257.95 | | |
| 8846 | Lighting..... | 22.97 | 52.83 | 75.80 | 7 drops | 10.82 |
| 8848 | Painting..... | 28.00 | 8.00 | 36.00 | 26 sash | 1.38 |
| 8849 | Machinery..... | 53.07 | 912.00 | 965.07 | | |
| .1 | Motor..... | 9.00 | 116.77 | 125.77 | 5 h.p. | 25.15 |
| .2 | Shafting, pulleys and belting... | 23.39 | 170.17 | 193.56 | 26 lin. ft. | 7.44 |

Total cost—Sample room..... \$2,826.11

8900.—Miscellaneous Accounts

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--|--|----------|------------|-------------|-------------|-----------------|
| 8902 | Sewer system, cost of pipe and laying..... | \$778.83 | \$1,224.72 | \$2,003.55 | 2,967 ft. | \$0.68 |
| .1 | " excavation..... | 2,122.84 | 65.20 | 2,188.04 | 2,967 ft. | 0.74 |
| .2 | " concrete..... | 168.18 | 184.08 | 352.26 | 53.8 ft. | 6.55 |
| 8903 | Outside closets..... | 879.05 | 227.78 | 1,106.83 | 3 closets | 368.94 |
| 8905 | Permanent outside lighting..... | 183.02 | 177.99 | 361.01 | 5 ares | 72.20 |
| 8906 | Water pipe lines excavation.... | 868.11 | ..... | 868.11 | 4,253 ft. | 0.20 |
| .01 | " concrete..... | 17.37 | 17.86 | 35.23 | 2.3 cu. yd. | 15.32 |
| .02 | " cost and laying..... | 2,863.32 | 2,062.07 | 4,925.39 | 4,253 ft. | 1.16 |
| .1 | 6-in. pipe line to Clifton..... | 1,474.71 | 6,914.95 | 8,389.66 | 8,988 ft. | 0.93 |
| .2 | Water supply tank, excavation.. | 143.68 | ..... | 143.68 | 116 cu. yd. | 1.24 |
| .4 | " cost and erection..... | ..... | ..... | 4,137.03 | 33.67 tons | 122.87 |
| 8908 | Power distribution..... | 3,233.02 | 7,407.21 | 10,640.23 | 17,370 ft. | 0.61 |
| 8909 | Permanent air line, excavation.. | 267.50 | ..... | 267.50 | 401 cu. yd. | 0.67 |
| .1 | " laying..... | 432.37 | 623.08 | 1,055.45 | 2,316 ft. | 0.46 |
| 8961 | Steam heating system, excavation..... | 166.36 | ..... | 166.36 | 225 cu. yd. | 0.73 |
| .1 | " cost and installation..... | 210.78 | 305.37 | 516.15 | 496 ft. | 1.10 |
| Total cost—Miscellaneous accounts..... | | | | \$37,186.48 | | |

8999.—Charges to Indirect Expense

| NUMBER | NAME OF ACCOUNT | TOTAL | TOTAL | TOTAL | TOTAL |
|--------|--|-----------|--------|---|----------------|
| 7001 | General expense at Clifton..... | \$13.58 | 8941 | Temporary railway receiving bins..... | 243.78 |
| 7004 | Personal injuries..... | 6,734.01 | 8942 | Water supply..... | 2,372.63 |
| 8901 | Derricks and construction equipment..... | 18,718.35 | 8943 | Corral expense..... | ..... |
| 8904 | Telephone system..... | 3,229.40 | 8944 | Switching and freight from Clifton..... | 2,661.35 |
| 8905.1 | Temporary outside lighting..... | 18.30 | 8945 | Office stationery and supplies..... | 1,369.68 |
| 8907 | Watchman's house..... | 1,516.69 | 8946 | Warehouse operating expense..... | 10,771.88 |
| 8908.1 | Temporary oil tanks..... | 382.75 | 8947 | Time-keeping expense ... | 4,346.59 |
| 8910 | Transmission of power to various departments.... | ..... | 8948 | Form lumber..... | ..... |
| 8911 | Watchman's house..... | 185.39 | 8949 | Cement..... | ..... |
| 8912 | Tool shed..... | 725.75 | 8951 | Sand and gravel..... | ..... |
| 8913 | Barn and corral..... | 2,100.53 | 8952 | Employee quarters..... | 2,192.98 |
| 8914 | Temporary blacksmith shop..... | 251.71 | 8953 | Crushing plant operating expense..... | ..... |
| 8916 | " power plant..... | 5,518.11 | 8954 | Concrete, power and repairs..... | ..... |
| 8917 | " crushing plant..... | 4,555.07 | 8955 | Mortar sand..... | ..... |
| 8918 | " water tank..... | 1,991.31 | 8955.1 | Mortar lime..... | ..... |
| 8919 | " electrical shop equipment..... | 322.16 | 8955.2 | Mortar cement..... | ..... |
| 8920 | Wagon roads..... | 1,215.33 | 8955.4 | Fire brick mortar..... | ..... |
| 8921 | Temporary pumping plant..... | 375.25 | 8955.5 | Silica brick mortar..... | ..... |
| 8922 | " pipe lines..... | 5,199.73 | 8956 | Operating temporary power house..... | ..... |
| 8923 | " warehouse..... | 1,810.24 | 8957 | Maintenance of tracks in yards..... | 2,800.31 |
| 8924 | " cement sheds..... | 801.10 | 8958 | Ditch at tunnel No. 2.... | 5,851.89 |
| 8925 | Horses, harness and carts..... | 2,616.40 | 8975 | Cleaning up..... | 4,996.20 |
| 8926 | Temporary office..... | 1,195.86 | 8976 | Rehandling brick and tile.. | 53.02 |
| 8927 | " closets..... | 146.65 | 8998 | Direct charges..... | 4,316.30 |
| 8928 | " machine shop..... | 166.10 | 8999 | Total charges to indirect expense..... | \$140,277.72 |
| 8929 | Employee railroad transportation..... | 16,991.57 | | Total unit cost..... | 7.53 per cent. |
| 8930 | Clearing land..... | 466.67 | | This percentage is obtained by dividing the total charges to indirect expense by the total cost of the smelter, minus engineering and indirect expense. | |
| 8931 | Test holes..... | 109.48 | | | |
| 8933 | Furniture and fixtures.... | 365.25 | | | |
| 8934 | Miscellaneous supplies.... | 4,436.24 | | | |
| 8935 | Shop equipment..... | 657.68 | | | |
| 8936 | Overhead shop expense.... | 8,394.19 | | | |
| 8937 | Stock lumber..... | ..... |  |  |  |
| 8938 | Powder magazine..... | 241.37 | | | |
| 8939 | Miscellaneous labor..... | 6,825.89 | | | |

\$140,277.72
1,864,092.47 = 7.53 per cent.

9000. Power Plant

Power House

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | UNIT |
|---------|---------------------------------------|------------|-----------|------------|-----------------------|----------|
| 9000.1 | Power plant engineering | | | | | See page |
| 9001 | Excavation | \$7,727.56 | \$69.09 | \$7,796.65 | 7,413 cu. yd. | \$ |
| 9002 | Bldg. foundation piers | 1,699.92 | 1,160.02 | 2,859.94 | 231.7 cu. yd. | 1 |
| .1 | " " walls | 3,735.78 | 3,628.81 | 7,364.59 | 508.5 cu. yd. | 1 |
| .2 | North tunnel | 1,350.79 | 1,230.37 | 2,581.16 | 180.3 cu. yd. | 1 |
| .3 | Concrete drain | 205.68 | 227.37 | 433.05 | 31.6 cu. yd. | 1 |
| .4 | Basement floor, concrete | 916.41 | 1,347.78 | 2,264.19 | 12,130 sq. ft. | |
| .45 | " painting | 81.45 | 48.81 | 130.26 | 830 sq. yd. | |
| .6 | Preparation of concrete for painting | 891.73 | 42.69 | 934.42 | 7,149 sq. yd. | |
| .7 | Painting concrete | 195.84 | 301.61 | 497.45 | 2,139 sq. yd. | |
| 9003 | Steel structure | | | 23,474.30 | 234.29 tons | 9 |
| .1 | Tile walls | 3,856.83 | 1,510.20 | 5,367.03 | 14,343 cu. ft. | |
| .11 | Unloading tile | 332.40 | 0.17 | 332.57 | 5,727.70 tons | |
| .12 | Wall coping | 372.09 | 107.05 | 479.14 | 732 lin. ft. | |
| .2 | Doors, window and frames | 974.38 | 3,319.93 | 4,294.31 | 1,044 sq. ft. opening | |
| 9003.21 | Concrete sills | 596.33 | 120.90 | 717.23 | 964 lin. ft. | |
| .3 | Ventilators | 125.60 | 439.76 | 565.36 | 6 ventilators | 9 |
| .4 | Main floor columns | 236.93 | 626.14 | 863.07 | 86 columns | 1 |
| .41 | Main floor slab concrete | 1,267.91 | 3,311.61 | 4,579.52 | 10,210 sq. ft. | |
| .42 | Painting under side main floor | 181.88 | 117.38 | 299.26 | 2,629 sq. yd. | |
| .43 | " top main floor | 95.56 | 199.32 | 294.88 | 1,114 sq. yd. | |
| .5 | Roof, Berger multiplex plate | 420.83 | 3,064.18 | 3,484.01 | 214 sq. ft. plates | 1 |
| .51 | " concrete | 1,723.10 | 958.51 | 2,681.61 | 214 sq. ft. | 1 |
| .52 | " tar | 172.70 | 127.74 | 300.44 | 214 sq. ft. | |
| .53 | " down spouts and tile drain | 286.17 | 510.14 | 796.31 | 905 ft. | |
| .54 | " painting under-side | 692.84 | 324.55 | 1,017.39 | 6,814 sq. yd. | |
| .55 | " P. & B. roofing | 577.08 | 1,117.08 | 1,694.16 | 214 sq. ft. plates | |
| .60 | Painting sash | 280.00 | 16.73 | 296.73 | 299 sash | |
| .61 | Painting woodwork | 20.50 | 4.00 | 24.50 | 89 sq. yd. | |
| 9004 | Crane | 131.89 | 1,723.27 | 1,855.16 | 1 crane | 1,85 |
| 9005 | Well grading | 1,558.07 | 517.68 | 2,075.75 | 2,000 cu. yd. | |
| .1 | Shaft sinking | 765.63 | 612.19 | 1,377.82 | 45 ft. | 3 |
| .2 | Timbering | 57.01 | | 57.01 | 45 ft. | |
| .31 | Aldrich pump installation | 74.56 | 10.62 | 85.18 | | |
| 9006.01 | Nordberg blowers | | | | | |
| | foundation | 774.06 | 1,020.83 | 1,794.89 | 686.1 cu. yd. | |
| .1 | " cost and installation | 1,641.62 | 32,514.02 | 34,155.64 | 2 Nordberg bls. | 17.07 |
| .2 | " painting | 327.57 | 57.65 | 385.22 | 2 " | 19 |
| 9007.01 | Turbines, foundation | 959.08 | 1,432.70 | 2,391.78 | 186.3 cu. yd. | 1 |
| .1 | " cost and installation | 2,297.70 | 79,586.49 | 81,884.19 | 4 turbines | 27.29 |
| .2 | " painting | 286.15 | 41.02 | 327.17 | 1 " | 10 |
| .3 | " air pipe mucking | 547.68 | 200.75 | 748.43 | 104 ft. | |
| .4 | " air pipe erection | 232.57 | 61.24 | 293.81 | 104 ft. | |
| .51 | Transformer trucks and transfer table | 121.63 | 519.28 | 640.91 | 15 trucks | 4 |
| .52 | Auto transformers | 715.60 | 12,044.91 | 12,760.51 | 10 transformers | 1.27 |
| 9008.01 | Condensers foundations | 991.08 | 985.16 | 1,976.24 | 20.3 cu. yd. | |

9000.—Power Plant (Continued)

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|---------|---|----------|-----------|-----------|---------------|-----------------|
| 9008.1 | " cost and installation..... | 415.31 | 19,563.55 | 19,978.86 | 3 condensers | 6,659.62 |
| .2 | " painting..... | 30.00 | 5.86 | 35.86 | 3 " | 11.95 |
| 9009 | Jet condenser hot well, excavation..... | 28.82 | 0.90 | 29.72 | 46 cu. yd. | 0.65 |
| .01 | " foundation..... | 66.27 | 69.99 | 136.26 | 16.5 " | 8.26 |
| .02 | " supporting struct. and tank..... | ..... | ..... | 945.74 | 5.76 tons | 164.19 |
| .03 | " cost and erection | 128.97 | 949.68 | 1,078.65 | 1 condenser | 1,078.65 |
| .12 | " dry vacuum pumps.... | 285.51 | 2,860.01 | 3,145.52 | 2 pumps | 1,572.76 |
| .13 | " " painting... | 30.00 | 5.86 | 35.86 | 2 " | 17.93 |
| .21 | Circulating pumps foundation..... | 560.04 | 708.93 | 1,268.97 | 210 cu. yd. | 6.04 |
| .22 | " cost and erection | 366.90 | 3,535.68 | 3,902.58 | 2 pumps | 1,951.29 |
| .23 | " painting..... | 30.00 | 5.86 | 35.86 | 2 " | 17.93 |
| 9010.01 | Air compressor foundation..... | 840.08 | 1,246.54 | 2,087.52 | 238.3 cu. yd. | 8.76 |
| .02 | " erection..... | 642.90 | 148.67 | 791.57 | ..... | ..... |
| .03 | " painting..... | 10.58 | 24.49 | 35.07 | ..... | ..... |
| .04 | " all piping except steam..... | 298.46 | 160.65 | 459.11 | ..... | ..... |
| .05 | " wrecking and transportation... | 457.77 | 136.06 | 593.83 | ..... | ..... |
| .06 | " installation of air receivers..... | 49.47 | 1.43 | 50.90 | ..... | ..... |
| 9011.01 | 2 exciters, 2 air pumps, 2 cir. pumps, found'n | 1,439.67 | 1,875.43 | 3,315.10 | 373 cu. yd. | 8.89 |
| .02 | 2 exciters, cost and installation..... | 491.01 | 6,118.26 | 6,609.27 | 2 exciters | 3,304.64 |
| .03 | 3 dry vacuum pumps, cost and installation | 147.26 | 3,190.10 | 3,337.36 | 3 pumps | 1,112.45 |
| .04 | 3 cir. pumps and engines, cost and installation..... | 389.32 | 8,729.37 | 9,118.69 | 3 " | 3,039.56 |
| .05 | 2 exciters, painting.... | 86.01 | 14.65 | 100.66 | 2 exciters | 50.33 |
| .06 | 3 air pumps, " | 50.00 | 8.79 | 58.79 | 3 pumps | 19.59 |
| .07 | 3 cir. " " | 81.69 | 14.65 | 96.34 | 3 " | 32.11 |
| 9012.01 | 2 motor gen., 1 air pump, 1 cir. pump., foundation..... | 296.52 | 658.91 | 955.34 | 107 cu. yd. | 8.93 |
| .02 | 2 motor generators, cost and installation..... | 319.06 | 6,830.33 | 7,149.39 | 2 generators | 3,574.69 |
| .05 | " painting..... | 30.00 | 5.86 | 35.86 | 2 " | 17.93 |
| 9013 | Transfer table pit, concrete..... | 24.13 | 58.23 | 82.36 | 12 cu. yd. | 6.86 |
| .01 | Switchboard concrete compartments..... | 1,472.21 | 510.48 | 1,982.69 | 1,469 sq. ft. | 1.35 |
| .02 | " cost and erection | 2,730.53 | 15,520.57 | 18,251.10 | ..... | ..... |
| 9014 | Steam piping north and south mains, excavation... | 249.65 | ..... | 249.65 | 279 cu. yd. | 0.89 |
| .01 | " " foundation... | 578.24 | 945.97 | 1,524.21 | 194.5 cu. yd. | 7.84 |
| .02 | " steel supporting structure..... | ..... | ..... | 7,694.58 | 86.81 tons | 88.64 |
| .03 | " hangers and anchors..... | 1,030.68 | 337.26 | 1,367.94 | 153 rods | 8.94 |
| .04 | " cost and erection | 2,286.31 | 18,622.25 | 20,908.56 | 3,401 ft. | 6.15 |
| .05 | " covering and erection..... | 266.71 | 5,813.23 | 6,079.94 | 3,401 ft. | 1.79 |

9000.—Power Plant (Continued)

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT Cost |
|--------|--|----------|-----------|-----------|---------------|-----------------------|
| 9015 | Exhaust pipe, cost and erection..... | 1,745.71 | 8,715.66 | 10,461.37 | 1,541 ft. | 6.79 |
| .01 | " painting..... | 85.05 | 51.19 | 136.24 | 1,541 ft. | 0.09 |
| .05 | " covering and erection..... | 318.25 | 830.56 | 1,148.81 | 746 ft. | 1.54 |
| .10 | Air piping, cost and erection..... | 363.19 | 554.16 | 917.35 | ..... | ..... |
| .11 | " painting..... | 31.56 | 18.66 | 50.22 | ..... | ..... |
| .2 | Exhaust pipe foundation..... | 63.09 | 102.81 | 165.90 | 18.3 cu. yd. | 9.07 |
| .21 | " supporting structure..... | 197.27 | 57.93 | 255.20 | ..... | ..... |
| .22 | " excavation..... | 20.82 | ..... | 20.82 | 29 cu. yd. | 0.72 |
| 9016 | Water pipe, excavation and backfill..... | 1,485.10 | 0.24 | 1,485.34 | 2,406 cu. yd. | 0.62 |
| .01 | " cost and erection | 3,747.79 | 16,437.88 | 20,185.87 | ..... | ..... |
| .02 | " painting..... | 230.59 | 25.54 | 256.13 | ..... | ..... |

Feed-water Heating Power

| | | | | | | |
|----------|---------------------------------------|--------|----------|----------|---------------------|--------|
| 9017 | Excavation..... | 239.39 | 1.70 | 241.09 | 274 cu. yd. | 10.88 |
| .01 | Foundation..... | 708.06 | 551.04 | 1,259.10 | 105.4 cu. yd. | 1.95 |
| .015 | Reinforced floors..... | 282.45 | 273.51 | 555.97 | 1,330 sq. ft. | 0.42 |
| .016 | Water-proofing concrete tanks..... | 80.65 | 14.46 | 95.11 | 1,475 sq. ft. | 80.06 |
| .02 | Steel structure..... | ..... | ..... | 2,262.90 | 26.63 tons | 4.98 |
| .021 | Distributing and equalizing tank..... | 364.70 | 260.58 | 625.28 | 80.2 cwt. | 7.80 |
| .03 | Tile work..... | 285.99 | 234.36 | 520.35 | 706 cu. ft. | 0.74 |
| .031 | Unloading tile..... | 24.91 | ..... | 24.91 | 30 tons | 0.83 |
| .032 | Coping..... | 14.83 | 14.01 | 28.84 | 108 lin. ft. | 0.27 |
| .033 | Sills and lintels..... | 7.81 | 5.57 | 13.38 | 60 lin. ft. | 0.22 |
| .034 | Painting tile walls... | 26.10 | ..... | 26.10 | 112 sq. yd. | 0.23 |
| 9017.035 | Doors, windows and frames..... | 59.83 | 99.98 | 159.81 | 186 sq. ft. opening | 0.86 |
| .04 | Roofing..... | 115.25 | 109.88 | 225.13 | 8.8 squares | 25.58 |
| .045 | Ventilators..... | 142.14 | 49.20 | 191.34 | 2 ventilators | 95.67 |
| .05 | Treating tank, concrete | 637.67 | 487.19 | 1,124.86 | 28.7 cu. yd. | 39.19 |
| .06 | Receiving tank No. 1. | 251.55 | 167.92 | 419.47 | 7.3 cu. yd. | 57.46 |
| .07 | Receiving tank No. 2.. | 364.50 | 265.08 | 629.58 | 24.4 cu. yd. | 25.80 |
| .08 | Calibrating tank..... | 188.96 | 50.21 | 239.17 | 12.6 cwt. | 18.98 |
| .081 | Tipping meter..... | 372.46 | 227.50 | 599.96 | 1 tipping meter | 599.96 |
| .09 | Heaters, recorder..... | 685.22 | 2,813.84 | 3,499.06 | ..... | ..... |
| .1 | Sewer excavation and backfill..... | 157.19 | ..... | 157.19 | 266 cu. yd. | 0.59 |
| .11 | Sewer pipe, cost and laying..... | 71.88 | 203.00 | 274.88 | 100 ft. | 2.75 |
| .12 | Lighting..... | 53.35 | 25.83 | 79.18 | 6 drops | 13.20 |
| .13 | Painting..... | 62.78 | 20.35 | 83.13 | ..... | ..... |
| .14 | Wood walkway and tank covers..... | 67.08 | 51.31 | 118.39 | 1.56 m.b.m. | 75.89 |
| .15 | Alterations..... | 99.70 | 3.40 | 103.10 | ..... | ..... |

Condensed Water Pump House

| | | | | | | |
|------|--------------------------------|----------|--------|----------|--------------------|--------|
| .20 | Excavation..... | 220.56 | 8.93 | 229.49 | 236 cu. yd. | 0.97 |
| .21 | Foundation..... | 1,171.89 | 854.68 | 2,026.57 | 171 cu. yd. | 11.85 |
| .22 | Floor..... | 78.41 | 57.70 | 136.11 | 355 sq. ft. | 0.38 |
| .24 | Doors, windows and frames..... | 26.02 | 22.68 | 48.70 | 57 sq. ft. opening | 0.85 |
| .242 | Tile work..... | 98.87 | 84.28 | 183.15 | 257 cu. ft. | 0.71 |
| .243 | Coping..... | 14.50 | 2.73 | 17.23 | 57 lin. ft. | 0.30 |
| .25 | Roof..... | 73.92 | 60.83 | 134.75 | 5 squares | 26.95 |
| .26 | Pumps and piping.... | 90.58 | 691.37 | 781.95 | 2 pumps | 390.98 |
| .27 | Lighting..... | 221.16 | 51.53 | 272.69 | ..... | ..... |

Power House Miscellaneous Accounts

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|-------------------------------|--------------------------------------|----------|----------|--------------|----------------|-----------------------|
| 9018.1 | Power and lighting transformers..... | 397.70 | 4,714.33 | 5,112.03 | 7 transformers | 730.29 |
| 9019 | Lighting..... | 307.86 | 1,449.97 | 1,757.83 | 94 drops | 18.70 |
| 9020 | Oiling system | 1,051.82 | 401.69 | 1,453.51 | 104 outlets | 13.98 |
| 9021 | Benches, bolt racks, etc. | 161.22 | 51.80 | 213.02 | | |
| 9022 | Instruments and gauges..... | 57.97 | 343.06 | 401.03 | | |
| Cooling Tower | | | | | | |
| 9050 | Excavation..... | 1,590.85 | 83.47 | 1,674.32 | 1,589 cu. yd. | 1.05 |
| .01 | Backfill..... | 1,395.20 | | 1,395.20 | 2,415 cu. yd. | 0.58 |
| 9051 | Foundations, sumps and gutters..... | 5,212.31 | 5,610.13 | 10,852.44 | 706.3 cu. yd. | 15.37 |
| .02 | Floor..... | 911.93 | 1,985.03 | 2,896.96 | 17,116 sq. ft. | 0.17 |
| .03 | Water proofing concrete..... | 588.76 | 130.50 | 719.35 | 1,606 sq. yd. | 0.45 |
| 9052 | Woodwork..... | 3,181.33 | 5,415.47 | 8,596.80 | 128.63 m.b.m. | 66.84 |
| 9053 | Alterations..... | 115.40 | 22.54 | 137.94 | | |
| Total cost—Cooling tower..... | | | | \$26,273.01 | | |
| Total cost—Power plant..... | | | | \$434,703.15 | | |

9060.—Oil Supply Sump and Pump House

| NUMBER | NAME OF ACCOUNT | LABOR | MATERIAL | TOTAL | QUANTITY | TOTAL UNIT COST |
|--------|---------------------------|------------|----------|------------|---------------------|-----------------------|
| 9060 | Excavation..... | \$1,148.78 | \$108.24 | \$1,257.02 | 1,308 cu. yd. | \$0.96 |
| .01 | Concrete work..... | 2,338.72 | 3,230.46 | 5,569.18 | 340.6 cu. yd. | 16.35 |
| .02 | Pumps..... | 176.20 | 2,035.58 | 2,211.78 | 2 pumps | 1,105.89 |
| .03 | Inlet piping..... | 44.77 | 126.55 | 171.32 | 108 ft. | 1.59 |
| .04 | Lighting..... | 79.71 | 62.57 | 142.28 | 4 drops | 35.57 |
| .05 | Steel work..... | 96.94 | 120.39 | 226.33 | 1.12 tons | 202.08 |
| .06 | Doors, windows and frames | 83.60 | 65.02 | 148.62 | 124 sq. ft. opening | 1.20 |
| .07 | Roof..... | 136.81 | 162.66 | 299.47 | 6.5 squares | 46.07 |
| .075 | Ventilators..... | 95.75 | 64.32 | 160.07 | 2 ventilators | 80.03 |

Two 500,000 Gallon Oil Tanks

| | | | | | | |
|---------|----------------------------------|----------|--------|----------|---------------|-------|
| 9060.10 | Wrecking and transportation..... | 934.00 | 465.31 | 1,399.31 | 64.40 tons | 21.73 |
| .11 | Excavation..... | 308.20 | | 308.20 | 554 cu. yd. | 0.56 |
| .12 | Foundation..... | 128.70 | 210.61 | 339.31 | 32.8 cu. yd. | 10.35 |
| .13 | Erection..... | 3,602.89 | 429.47 | 4,032.36 | 64.40 tons | 62.62 |
| .131 | Roof supports..... | 362.90 | 359.83 | 722.73 | 65.56 squares | 11.02 |
| .132 | Sheathing, lath and plaster | 399.05 | 523.01 | 922.05 | 75.50 squares | 12.22 |

Tracks at Oil Sump

| | | | | | | |
|---------|---------------------------|----------|----------|----------|---------------|-------|
| 9060.14 | Railroad grading..... | 1,477.27 | | 1,477.27 | 2,439 cu. yd. | 0.61 |
| .15 | Laying and ballasting.... | 1,107.38 | 1,092.99 | 2,200.37 | 1,362 ft. | 1.62 |
| .16 | Track bumpers..... | 246.74 | 47.92 | 294.66 | 3.16 m.b.m. | 93.25 |
| .17 | Bridges over wood pipe... | 229.22 | 87.14 | 316.36 | | |

Oil Supply Tanks for Reverberatories and Boilers

| | | | | | | |
|---------|------------------------|--------|----------|----------|---------------|--------|
| 9060.20 | Excavation..... | 392.13 | 13.18 | 405.31 | 404 cu. yd. | 1.00 |
| .21 | Foundation..... | 875.70 | 1,685.76 | 2,561.46 | 189.5 cu. yd. | 13.52 |
| .22 | Cost and erection..... | | | 3,926.67 | 8 tanks | 487.94 |
| .23 | Piping..... | 199.41 | 282.16 | 481.57 | 785 ft. | 0.61 |

Oil Piping

| | | | | | | |
|---------|---------------------------|----------|----------|----------|---------------|------|
| 9060.40 | Excavation..... | 990.73 | 1.39 | 992.12 | 1,150 cu. yd. | 0.86 |
| .41 | Pipe and laying..... | 3,156.14 | 5,654.50 | 8,810.64 | 1,888 ft. | 4.67 |
| 9060.50 | Heating installation..... | 167.37 | 1,068.04 | 1,235.41 | 360 ft. | 3.43 |

NEW SMELTER

Recapitulation of Costs

| Number | NAME OF ACCOUNT | Total \$100,000.00 | Number | NAME OF ACCOUNT | Total |
|--------|------------------------------------|-----------------------|--------|-----------------------------------|-------------|
| 7100 | Engineering expense | | 8020 | Roaster dust chamber flue | 12,850 |
| 7300 | Yard tracks and delivery system | 136,326.43 | 8700 | Boiler and blacksmith shop | 21,450 |
| 7400 | Receiving bins | 11,183.06 | 8714 | Machine and carpenter shop | 27,300 |
| 7700 | Crushing plant | 9,268.62 | 8800 | General office | 1,300 |
| 7800 | Sampling plant | 31,108.74 | 8800 | Warehouse | 13,000 |
| 7900 | Bedding plant and banker bins | 150,000.00 | 8810 | Laboratory | 6,100 |
| 8100 | Roasting plant | 136,734.87 | 8840 | Sample room | 2,800 |
| 8120 | Roaster dust chamber | 49,664.76 | 8800 | Miscellaneous accounts | 37,100 |
| 8300 | Reverberatory plant | 324,945.02 | 8900 | Indirect expense | 140,200 |
| 8400 | Converter plant | 216,933.37 | 9000 | Power plant | 434,700 |
| 8420 | Converter dust chamber | 27,813.58 | 9060 | Oil supply pump and pump house | 40,000 |
| 8500 | Conveying system | 45,411.15 | | | |
| 8600 | Chimney | 13,453.70 | | | |
| 8610 | Reverberatory flue | 7,602.88 | | Total cost | \$2,103,000 |
| 8620 | Converter flue | | | | |

CHAPTER II

COMPARATIVE COSTS

Plain Concrete

| Number | NAME OF ACCOUNT | Labor Cost | | Material Cost | | Total Cost |
|---------|-------------------------------------|------------|----------|---------------|------------|------------|
| | | Per Yd | Amount | Per Yd | Amount | |
| 7308 1 | Trestle approach to trolley | 254.0 | \$176.18 | \$1.00 | \$1,152.42 | \$1,328.60 |
| 7309 1 | Track scales receiving ing yard | 180.0 | \$45.02 | 2.00 | 1,126.87 | 1,092.49 |
| 7310 | Bridge No. 1 | 310.0 | 1,024.20 | 3.00 | 1,008.38 | 2,006.64 |
| 7312 1 | Retaining wall | 203.5 | 512.04 | 2.52 | 714.25 | 1,246.59 |
| 7313 1 | Caliche track scales | 41.0 | 207.55 | 4.00 | 103.60 | 401.15 |
| 7314 1 | Approach to receiving bins | 754.3 | 2,404.10 | 3.10 | 3,017.95 | 5,422.11 |
| 7402 | Receiving bins | 612.3 | 1,235.51 | 2.02 | 2,247.70 | 3,483.21 |
| 7802 | Sampling plant | 120.7 | 605.91 | 5.02 | 649.44 | 1,255.35 |
| 8102 | Roaster plant | 250.5 | 765.43 | 3.00 | 1,060.63 | 1,825.05 |
| 8122 | Roaster dust chamber | 472.0 | 1,049.74 | 2.22 | 1,775.05 | 2,824.76 |
| 8300 1 | Flues from boilers to power flue | 0.2 | 74.00 | 8.07 | 71.02 | 145.02 |
| 8402 1 | Converter shaft | 170.8 | 565.53 | 3.10 | 1,311.03 | 1,876.56 |
| 8410 2 | Roller scales | 10.5 | 58.92 | 5.55 | 65.10 | 124.02 |
| 8422 | Converter dust chamber flue | 280.4 | 666.85 | 2.33 | 1,209.97 | 1,876.82 |
| 8426 20 | Web pan | 7.5 | 55.80 | 7.10 | 55.96 | 109.26 |
| 8602 | Chimney | 872.2 | 624.42 | 0.25 | 4,100.65 | 4,725.07 |
| 8622 | Converter flue | 147.0 | 105.75 | 1.17 | 652.69 | 758.44 |
| 8627 | Roaster dust chamber flue | 114.6 | 214.35 | 1.00 | 551.24 | 765.59 |
| 8702 | Boiler and blacksmith shop | 24.7 | 416.57 | 5.20 | 584.19 | 1,000.76 |
| 8710 | Machine and carpenter shop | 405.5 | 792.05 | 7.01 | 584.00 | 1,376.05 |
| 8811 | Warehouse | 123.0 | 810.10 | 7.14 | 650.70 | 1,460.80 |
| 8842 | Sample room | 9.0 | 41.80 | 6.10 | 64.43 | 106.23 |
| 8901 | Indirect and general expenses | 55.8 | 260.10 | 3.12 | 581.04 | 841.14 |

Plain Concrete (Continued.)

| NUMBER | NAME OF ACCOUNT | CU. YD. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|------------|----------------------------------|---------|-------------|-------------|---------------|-------------|-------------|-------------|
| | | | AMOUNT | PER CU. YD. | AMOUNT | PER CU. YD. | AMOUNT | PER CU. YD. |
| 8906.01 | Water pipe lines, etc. | 2.3 | 17.37 | 7.55 | 17.85 | 7.76 | 35.23 | 15.31 |
| 8908.2 | Power conduits..... | 27.6 | 198.14 | 7.18 | 217.15 | 7.87 | 415.29 | 15.04 |
| 8908.5 | Power conduit branches..... | 5.0 | 25.36 | 5.07 | 30.63 | 6.12 | 55.99 | 11.19 |
| 8916 | Temporary power plant..... | 14.4 | 56.04 | 3.89 | 98.69 | 6.86 | 154.73 | 10.75 |
| 8917 | " crushing plant.. | 101.1 | 303.15 | 3.00 | 531.13 | 5.28 | 837.28 | 8.28 |
| 8918 | " oil and water tanks..... | 48.8 | 140.27 | 3.06 | 263.01 | 5.39 | 412.28 | 8.45 |
| 9002 | Power plant..... | 231.7 | \$1,699.92 | \$7.34 | \$1,460.02 | \$6.30 | \$3,159.94 | \$13.64 |
| 9002.3 | " drain..... | 34.6 | 205.68 | 5.94 | 227.37 | 6.57 | 433.05 | 12.52 |
| 9006.01 | " Nordberg engines..... | 686.3 | 774.06 | 1.13 | 3,020.83 | 4.40 | 3,794.89 | 5.53 |
| 9007.01 | " turbines..... | 196.5 | 959.08 | 4.88 | 1,432.70 | 7.29 | 2,391.28 | 12.16 |
| 9008.01 | " condensers..... | 50.3 | 291.08 | 5.79 | 285.18 | 5.67 | 576.26 | 11.45 |
| 9009.01 | " jet condenser... | 16.5 | 66.27 | 4.02 | 69.99 | 4.24 | 136.26 | 8.26 |
| 9009.21 | " 2 air pumps.... | 210.0 | 560.04 | 2.67 | 708.93 | 3.37 | 1,268.97 | 6.04 |
| 9010.01 | " air compressor.. | 238.3 | 840.98 | 3.53 | 1,246.54 | 5.23 | 2,087.52 | 8.76 |
| 9011.01 | " exciters, etc.... | 373.0 | 1,439.67 | 3.86 | 1,875.43 | 5.03 | 3,315.10 | 8.89 |
| 9012.01 | " motor generators..... | 107.0 | 296.52 | 2.77 | 658.91 | 6.16 | 955.43 | 8.93 |
| 9014.01 | North and south steam mains..... | 194.5 | 578.24 | 2.97 | 945.97 | 4.86 | 1,524.21 | 7.84 |
| 9015.2 | Power plant exhaust pipe..... | 18.3 | 63.09 | 3.45 | 102.81 | 5.62 | 165.90 | 9.07 |
| Total..... | | 7,779.4 | \$22,391.30 | \$2.85 | \$37,593.53 | \$4.82 | \$59,984.83 | \$7.67 |

Miscellaneous Concrete

| NUMBER | NAME OF ACCOUNT | CU. YD. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|------------|---|---------|-------------|-------------|---------------|-------------|-------------|-------------|
| | | | AMOUNT | PER CU. YD. | AMOUNT | PER CU. YD. | AMOUNT | PER CU. YD. |
| 7702 | Crusher plant..... | 220.5 | \$893.15 | \$4.05 | \$1,568.47 | \$7.11 | \$2,461.62 | \$11.16 |
| 7902 | Bedding plant..... | 2,809.7 | 6,256.34 | 2.23 | 14,513.21 | 5.16 | 20,769.55 | 7.39 |
| 8302 | Reverberatory plant | 2,810.0 | 7,715.96 | 2.74 | 15,044.09 | 5.35 | 22,760.05 | 8.10 |
| 8307.11 | Waste heat boilers.. | 138.7 | 789.52 | 5.69 | 793.97 | 5.72 | 1,583.49 | 11.42 |
| 8307.12 | Oil-fired boilers..... | 100.0 | 350.45 | 3.50 | 686.29 | 6.86 | 1,036.74 | 10.37 |
| 8307.13 | Feed pumps..... | 214.7 | 678.73 | 3.16 | 1,428.97 | 6.66 | 2,107.70 | 9.82 |
| 8402 | Converter plant.... | 776.9 | 1,796.56 | 2.31 | 2,860.16 | 3.68 | 4,656.72 | 6.00 |
| 8414 | Casting machines... | 291.9 | 1,627.37 | 5.58 | 1,889.36 | 6.47 | 3,516.73 | 12.05 |
| 8502 | Conveying system... | 622.3 | 2,550.78 | 4.10 | 4,006.37 | 6.44 | 6,557.15 | 10.54 |
| 8821 | Laboratory..... | 96.5 | 448.42 | 4.65 | 575.13 | 5.96 | 1,023.55 | 10.61 |
| 8902.2 | Sewer system..... | 53.8 | 168.18 | 3.13 | 184.08 | 3.42 | 352.26 | 6.55 |
| 9013 | Transfer table pit... | 12.0 | 24.13 | 2.01 | 58.23 | 4.85 | 82.36 | 6.86 |
| 9017.01 | Feed water heating plant..... | 105.4 | 708.06 | 6.72 | 551.04 | 5.23 | 1,259.10 | 11.95 |
| 9017.21 | Condensed water pump house..... | 171.0 | 1,171.89 | 6.85 | 854.68 | 5.00 | 2,026.57 | 11.85 |
| 9060.21 | Supply tanks, reverbs. and oil-fired boilers..... | 189.5 | 875.70 | 4.62 | 1,685.76 | 8.90 | 2,561.46 | 13.52 |
| Total..... | | 8,706.1 | \$26,055.24 | \$2.99 | \$46,699.81 | \$5.36 | \$72,755.05 | \$8.36 |

Reinforced Concrete

| NUMBER | NAME OF ACCOUNT | CU. YD. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|---------|------------------------------------|----------|-------------|-------------|---------------|-------------|--------------|-------------|
| | | | AMOUNT | PER CU. YD. | AMOUNT | PER CU. YD. | AMOUNT | PER CU. YD. |
| 8307.10 | Reverb. boiler bldg. | 573.7 | \$2,181.08 | \$3.80 | \$3,846.48 | \$6.70 | \$6,027.26 | \$10.50 |
| 8612 | Reverberatory flue. | 487.8 | 1,657.09 | 3.40 | 3,886.80 | 7.97 | 5,543.89 | 11.3 |
| 9002.1 | Power house..... | 508.5 | 3,733.78 | 7.35 | 3,678.81 | 7.24 | 7,364.59 | 14.5 |
| .2 | North tunnel..... | 180.3 | 1,330.79 | 7.49 | 1,230.67 | 6.83 | 2,561.36 | 14.3 |
| 9051 | Cooling tower..... | 706.3 | 5,312.31 | 7.53 | 5,640.13 | 7.99 | 10,952.44 | 15.5 |
| 9060.01 | Oil supply sump and pump house. | 340.6 | 2,338.72 | 6.87 | 3,230.46 | 9.48 | 5,569.18 | 16.3 |
| .12 | Oil storage tanks . | 32.8 | 128.70 | 3.92 | 710.61 | 6.42 | 839.31 | 25.3 |
| | Total..... | 2,830.0 | \$16,601.17 | \$5.87 | \$21,073.56 | \$7.66 | \$38,278.03 | \$13.53 |
| | Total concrete foundations..... | 19,313.5 | \$65,051.01 | \$3.37 | \$10,966.00 | \$5.48 | \$171,017.91 | \$8.86 |

Plain Concrete Floors

| NUMBER | NAME OF ACCOUNT | Sq. Ft. | THICK- NESS | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|---------|--|------------|----------------|------------|------------|---------------|------------|------------|------------|
| | | | | AMOUNT | Sq. Ft. | AMOUNT | Sq. Ft. | AMOUNT | Sq. Ft. |
| 7802.1 | Sampling plant, ground floor..... | 1,222 | 5 in | \$165.68 | \$0.09 | \$264.92 | \$0.21 | \$430.60 | \$0.30 |
| 8307.3 | Around boilers..... | 2,705 | 4 " | 276.29 | 0.10 | 664.82 | 0.25 | 941.11 | 0.35 |
| 8812.41 | Warehouse floor and platform.... | 8,298 | 4 " | 358.94 | 0.07 | 724.60 | 0.09 | 1,083.54 | 0.16 |
| 8821.1 | Laboratory..... | 1,626 | 4 " | 114.78 | 0.11 | 174.90 | 0.15 | 289.68 | 0.26 |
| 8842.1 | Sample room..... | 489 | 5 " | 64.17 | 0.11 | 73.25 | 0.15 | 137.42 | 0.26 |
| 9002.4 | Power plant base- ment..... | 12,130 | 5 " | 916.44 | 0.07 | 1,447.78 | 0.11 | 2,364.22 | 0.18 |
| 9017.22 | Condensed water pump house..... | 355 | 4 " | 78.41 | 0.22 | 57.70 | 0.16 | 136.11 | 0.38 |
| | | 26,225 | | \$2,111.78 | \$0.09 | \$4,285.97 | \$0.11 | \$6,397.75 | \$0.20 |
| | The above concrete floors were laid in small blocks 5 ft by 8 ft square, leaving a finished top surface level with and joints between all squares. | | | | | | | | |
| 8416.11 | Loading platform.. | 6,803 | 5 in | 381.92 | 0.09 | 1,064.55 | 0.15 | 1,446.47 | 0.24 |
| | The floor above was finished as a large slab with no panel joints. | | | | | | | | |

Reinforced Concrete Floors

| NUMBER | NAME OF ACCOUNT | Sq. Ft. | THICKNESS | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|----------|-------------------------------|---------|-----------|------------|-------------|---------------|-------------|------------|-------------|
| | | | | AMOUNT | PER SQ. FT. | AMOUNT | PER SQ. FT. | AMOUNT | PER SQ. FT. |
| 7802.2 | Sampling plant.... | 4,244 | 4 1/2 " | \$1,050.00 | \$0.25 | \$1,050.00 | \$0.25 | \$2,100.00 | \$0.50 |
| 8307.2 | Over slag track cut | 7,679 | 5 " | 1,014.17 | 0.13 | 1,795.29 | 0.23 | 2,809.46 | 0.36 |
| 8821.1 | Laboratory..... | 364 | 4 1/2 " | 59.61 | 0.16 | 112.94 | 0.31 | 172.55 | 0.47 |
| 9017.015 | Feed water heating plant..... | 1,300 | 4 1/2 " | 250.46 | 0.19 | 723.31 | 0.55 | 973.77 | 0.74 |
| | | | | | | | | | |
| | | | | \$2,414.24 | \$0.19 | \$3,581.54 | \$0.27 | \$6,005.78 | \$0.46 |

The floors above were furnished, respectively, with 240, 220, 200, and 180

| | | | | | | | | | | |
|---------|--|--------|------|---|---------|-----------|-----------|------|----------|-----|
| 9003.41 | Power plant main floor..... | 10,210 | 4 sq | 1 | 207' 0" | x 12' | x 12' 6" | = 11 | 8,000 sq | (6) |
| | The floor above was laid on Berger plate steel beams (see illustration) | | | | | | | | | |
| 9051.02 | Power plant cooling tower..... | 17,114 | 4 sq | 5 | 111' 0" | x 111' 0" | x 111' 0" | = 12 | 2,400 sq | (6) |
| | The floor above was reinforced, laid on the ground and straightened gravel at width, no beams. | | | | | | | | | |

The floor above was reinforced, and on the ground floor the roof was reinforced.

Coping

| NUMBER | NAME OF ACCOUNT | LIN. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|----------|--|------|------------|------------|---------------|------------|------------|------------|
| | | | AMOUNT | PER Ft. | AMOUNT | PER Ft. | AMOUNT | PER Ft. |
| 8703.22 | Boiler and blacksmith shop. . . . | 290 | \$112.17 | \$0.38 | \$2.72 | \$0.01 | \$114.89 | \$0.40 |
| 8717.22 | Machine and carpenter shop. . . . | 320 | 121.67 | 0.37 | 23.70 | 0.08 | 145.37 | 0.45 |
| 8812.22 | Warehouse. | 320 | 176.60 | 0.55 | 36.53 | 0.12 | 213.13 | 0.67 |
| 9017.243 | Condensed water pump house. . . | 57 | 11.50 | 0.25 | 2.73 | 0.01 | 17.23 | 0.30 |
| | | 987 | \$424.94 | \$0.43 | \$65.68 | \$0.07 | \$490.62 | \$0.50 |
| | This coping was 12 in. deep, projecting 2 in. from tile work | | | | | | | |
| 9003.12 | Power house. | 732 | \$372.69 | \$0.51 | \$107.05 | \$0.15 | \$479.74 | \$0.66 |
| | This coping was 18 in. deep, projecting 2 in. from tile work | | | | | | | |

Excavation --Type No. 1

This class covers shallow excavation made with picks, shovels, wheelbarrow and slips. The haul is less than 100 ft.

| NUMBER | NAME OF ACCOUNT | TOTAL COST. | CUB. YD. | COST PER CUB. YD. |
|------------|---------------------------------------|-------------|----------|----------------------|
| 7308 | Trestle approach to reverb. bldg..... | \$359.95 | 277 | \$1.30 |
| 7313 | Track scales on calcine track..... | 108.95 | 118 | 0.92 |
| 7314 | Trestles to receiving bins..... | 548.18 | 589 | 0.93 |
| 7801 | Sampling plant..... | 205.06 | 332 | 0.89 |
| 8410 | Air pipe line from power house..... | 221.06 | 331 | 0.68 |
| 8416 | Loading platform..... | 212.77 | 216 | 0.99 |
| 8419.1 | Bullion scales..... | 19.76 | 24 | 0.82 |
| 8501 | Conveying system..... | 1,824.22 | 2,286 | 0.80 |
| 8611 | Reverberatory flue..... | 936.93 | 1,588 | 0.59 |
| 8621 | Converter flue..... | 168.02 | 198 | 0.85 |
| 8626 | Roaster dust chamber flue..... | 225.37 | 213 | 1.06 |
| 8812.4 | Warehouse, floor..... | 129.03 | 66 | 1.96 |
| 8820 | Laboratory..... | 191.27 | 212 | 0.90 |
| 8841 | Sample room..... | 61.35 | 72 | 0.85 |
| 8902.1 | Sewer system..... | 2,188.04 | 2,808 | 0.78 |
| 8906 | Water pipe lines, tanks, etc..... | 868.11 | 1,078 | 0.81 |
| 8908 | Power conduit..... | 358.53 | 435 | 0.82 |
| 8908 | Power conduit branches..... | 49.20 | 53 | 0.93 |
| 8909 | Permanent air lines..... | 267.50 | 401 | 0.67 |
| 8922 | Temporary pipe lines..... | 169.13 | 148 | 1.14 |
| 8923 | Temporary warehouse..... | 47.29 | 87 | 0.54 |
| 9009 | Jet condenser not well..... | 29.72 | 46 | 0.65 |
| 9014 | North and south steam mains..... | 249.65 | 279 | 0.89 |
| 9015.22 | Exhaust pipe..... | 20.82 | 29 | 0.72 |
| 9017.20 | Condensed water pump house..... | 229.49 | 236 | 0.97 |
| 9060.40 | Oil piping..... | 992.12 | 1,150 | 0.86 |
| Total..... | | \$10,774.52 | 13,272 | \$0.81 |

Excavation—Type No. 2

This class covers excavation made with picks, shovels, slips and carts. The haul is over 100 ft. in every case.

| NUMBER | NAME OF ACCOUNT | TOTAL COST | Cu. Yd. | COST PER Cu. Yd. |
|------------|-------------------------------------|------------|---------|---------------------|
| 7309 | Track scales in receiving yard..... | \$348.91 | 388 | \$0.90 |
| 7312 | Retaining walls..... | 77.66 | 60 | 1.29 |
| 7701 | Crushing plant..... | 689.67 | 609 | 1.13 |
| 8306 | Flues from boilers to reverbs..... | 19.86 | 15 | 1.32 |
| 8307.01 | Waste heat boilers..... | 213.44 | 129 | 1.65 |
| 8307.03 | Feed pumps..... | 601.44 | 659 | 0.91 |
| 8404 | Converter stands..... | 258.88 | 304 | 0.85 |
| 8413 | Two casting machines..... | 520.82 | 512 | 1.02 |
| 8421 | Converter dust chamber..... | 127.28 | 265 | 0.48 |
| 8426.1 | Wet pan..... | 2.44 | 3 | 0.81 |
| 9017 | Feed water heating plant..... | 241.09 | 274 | 0.88 |
| 9050 | Cooling tower..... | 1,674.32 | 1,589 | 1.05 |
| 9060 | Oil supply sump and pump house..... | 1,257.02 | 1,308 | 0.96 |
| 9060.11 | Storage tanks..... | 308.20 | 554 | 0.56 |
| Total..... | | \$6,341.03 | 6,669 | \$0.95 |

Excavation—Type No. 3

This class covers excavation made with powder, picks, shovels and wheelbarrows. The haul was less than 100 ft.

| NUMBER | NAME OF ACCOUNT | TOTAL COST | Cu. Yd. | COST PER Cu. Yd. |
|------------|-------------------------------|------------|---------|---------------------|
| 8906.2 | Water supply tank..... | \$143.68 | 116 | \$1.24 |
| 8916 | Temporary power plant..... | 354.07 | 388 | 0.91 |
| 8917 | Temporary crushing plant..... | 57.00 | 156 | 0.37 |
| 8920 | Wagon road..... | 924.74 | 951 | 0.97 |
| 9005 | Well grading..... | 2,075.75 | 2,600 | 0.80 |
| Total..... | | \$3,555.24 | 4,211 | \$0.84 |

Excavation—Type No. 4

This class covers excavation made with powder, picks, shovels, slips, fresnos and carts. The haul was over 100 ft.

| NUMBER | NAME OF ACCOUNT | TOTAL COST | Cu. Yd. | COST PER Cu. Yd. |
|------------|--|-------------|---------|---------------------|
| 7901 | Bedding plant..... | \$12,259.43 | 12,319 | \$0.99 |
| 8101 | Roaster plant..... | 1,547.07 | 1,216 | 1.27 |
| 8307 | Reverb. boiler building..... | 283.14 | 306 | 0.93 |
| 8312.10 | Feed piping from heating plant to pumps..... | 1,091.42 | 1,296 | 0.84 |
| 9060.20 | Supply tank for reverbs. and boilers..... | 405.31 | 404 | 1.00 |
| Total..... | | \$15,586.37 | 15,541 | \$1.00 |

Excavation—Type No. 5

This class covers excavation done with plows, slips, fresnos, and in some cases powder. The haul was less than 100 ft.

| NUMBER | NAME OF ACCOUNT | TOTAL COST | Cu. Yd. | COST PER Cu. Yd. |
|------------|-----------------------------------|-------------|---------|---------------------|
| 8701 | Boiler and blacksmith shop..... | \$1,186.88 | 1,458 | \$0.82 |
| 9001 | Power house..... | 7,796.65 | 7,313 | 1.07 |
| 9060.14 | Railroad grading at oil sump..... | 1,477.27 | 2,439 | 0.61 |
| Total..... | | \$10,460.80 | 11,210 | \$0.93 |

Excavation—Type No. 6

This class covers excavation made with plows, slips, fresnos, and in some cases powder. The haul was over 100 ft.

| NUMBER | NAME OF ACCOUNT | TOTAL COST | Cu. Yd. | COST PER Cu. Yd. |
|------------|---------------------------|-------------|---------|---------------------|
| 8121 | Roaster dust chamber..... | \$1,112.83 | 1,194 | \$0.93 |
| 8301 | Reverberatory plant..... | 1,477.66 | 1,890 | 0.78 |
| 8307.02 | Oil-fired boilers..... | 73.60 | 97 | 0.76 |
| 8401 | Converter plant..... | 5,731.11 | 6,330 | 0.91 |
| 8601 | Chimney..... | 367.05 | 597 | 0.61 |
| 8715 | Machine shop..... | 1,941.11 | 1,765 | 1.10 |
| 8810 | Warehouse..... | 996.08 | 1,287 | 0.77 |
| Total..... | | \$11,699.44 | 13,160 | \$0.89 |

Excavation—Type No. 7

These are miscellaneous jobs where a variety of methods were used.

| NUMBER | NAME OF ACCOUNT | TOTAL COST | Cu. Yd. | COST PER Cu. Yd. |
|------------|--|-------------|---------|---------------------|
| 7301 | Yard tracks and industrial system..... | \$35,566.00 | 55,405 | \$0.64 |
| 8901 | Derricks and construction equip..... | 30.32 | 41 | 0.74 |
| 8905.01 | Permanent outside lighting..... | 17.87 | 21 | 0.85 |
| 8952 | Employee quarters..... | 401.63 | 318 | 1.26 |
| 8961 | Steam heating installation..... | 166.36 | 228 | 0.73 |
| 9016 | Power house water pipe..... | 1,485.34 | 2,406 | 0.62 |
| 9017.1 | Feed water heating plant..... | 157.19 | 266 | 0.59 |
| Total..... | | \$37,824.71 | 58,685 | \$0.64 |

Excavation—Type No. 8

This class covers excavation made with picks, shovels, wheelbarrows and carts. A large portion of it was windlassed from deep pits.

| NUMBER | NAME OF ACCOUNT | TOTAL COST | Cu. Yd. | COST PER Cu. Yd. |
|--------|---------------------|------------|---------|---------------------|
| 7401 | Receiving bins..... | \$2,342.27 | 1,428 | \$1.64 |

Excavation—Type No. 9

This covers backfilling and tamping in 4 to 5-in. layers.

| NUMBER | NAME OF ACCOUNT | TOTAL COST | Cu. Yd. | COST PER Cu. Yd. |
|-----------------------|------------------------------|--------------|---------|---------------------|
| 8301.01 | Reverberatory plant..... | \$2,755.55 | 3,079 | \$0.75 |
| 8307.04 | Reverb. boiler building..... | 548.10 | 972 | 0.56 |
| 8416.2 | Loading platform..... | 67.85 | 129 | 0.53 |
| 9050.01 | Cooling tower..... | 1,395.20 | 2,415 | 0.58 |
| Total..... | | \$4,766.70 | 7,195 | \$0.66 |
| Total excavation..... | | \$103,351.08 | 131,371 | \$0.79 |

Lighting

| NUMBER | NAME OF ACCOUNT | No. DROPS | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|------------|------------------------------------|--------------|------------|-------------|---------------|-------------|------------|-------------|
| | | | AMOUNT | PER DROP | AMOUNT | PER DROP | AMOUNT | PER DROP |
| 7407 | Receiving bins..... | 22 | \$60.87 | \$2.77 | \$24.67 | \$1.12 | \$85.54 | \$3.89 |
| 7707.1 | Crushing plant..... | 8 | 76.41 | 9.55 | 38.22 | 4.78 | 114.63 | 14.33 |
| 7806.1 | Sampling plant..... | 36 | 178.80 | 4.97 | 146.22 | 4.06 | 325.02 | 9.03 |
| 7906 | Bedding plant..... | 63 | 306.85 | 4.87 | 127.38 | 2.02 | 434.23 | 6.89 |
| 8109 | Roaster plant..... | 67 | 340.64 | 5.09 | 157.70 | 2.35 | 498.34 | 7.44 |
| 8313.1 | Reverb. and boiler bldg. | 104 | 612.30 | 5.89 | 473.19 | 4.55 | 1,085.49 | 10.44 |
| 8409.1 | Converter plant..... | 60 | 451.93 | 7.53 | 462.01 | 7.70 | 913.94 | 15.23 |
| 8506 | Conveying system..... | 33 | 189.86 | 5.76 | 84.56 | 2.56 | 274.42 | 8.32 |
| 8708 | Boiler and blacksmith shop..... | 17 | 23.41 | 1.38 | 44.50 | 2.62 | 67.91 | 4.00 |
| 8722 | Machine shop..... | 20 | 55.84 | 2.79 | 135.01 | 6.75 | 190.85 | 9.54 |
| 8812.50 | Warehouse..... | 26 | 45.09 | 1.73 | 70.48 | 2.71 | 115.57 | 4.45 |
| 8846 | Sample room..... | 7 | 22.97 | 3.28 | 52.83 | 7.54 | 75.80 | 10.82 |
| 9017.12 | Feed water heating plant | 6 | 53.35 | 8.89 | 25.83 | 4.31 | 79.18 | 13.20 |
| 9019 | Power house..... | 94 | 307.86 | 3.28 | 1,449.97 | 15.42 | 1,757.83 | 18.70 |
| Total..... | | 563 | \$2,726.18 | \$4.84 | \$3,292.57 | \$5.85 | \$6,018.75 | \$10.69 |

Cost and Erection of Machinery

| NUMBER | NAME OF ACCOUNT | CWT. | LABOR COST | | ERECTION COST | | TOTAL COST | |
|--------|-----------------|------|------------|-------------|---------------|-------------|------------|-------------|
| | | | AMOUNT | PER CWT. | AMOUNT | PER CWT. | AMOUNT | PER CWT. |

Group No. 1

| | | | | | | | | |
|-----------|--|-----------|------------|--------|-------------|--------|--------------|---------|
| 8313-8317 | Two electrical feed pumps..... | 433.45 | \$375.70 | \$0.87 | \$375.70 | \$0.87 | \$6,187.56 | \$14.28 |
| 8316 | Six No. 14 Wilgus oil systems..... | 84.75 | 111.48 | 1.32 | 123.82 | 1.46 | 1,973.77 | 23.29 |
| 8317.1 | Two steam feed pumps..... | 35.47 | 37.27 | 1.05 | 38.12 | 1.07 | 499.24 | 14.07 |
| 9006.1 | Two Nordberg blowers with air receivers..... | 3,832.42 | 1,641.62 | 0.43 | 3,080.52 | 0.80 | 34,155.64 | 8.91 |
| 9007.1 | Three Curtis tur- bines and ten auto transformers..... | 4,541.40 | 2,297.70 | 0.51 | 4,442.20 | 0.98 | 81,884.19 | 18.03 |
| 9009.12 | Two dry vacuum pumps for jet condenser..... | 242.00 | 285.51 | 1.18 | 517.38 | 2.14 | 3,145.52 | 13.00 |
| 9009.22 | Two circulating pumps..... | 375.60 | 366.90 | 0.98 | 433.78 | 1.15 | 3,902.58 | 10.39 |
| 9010.02 | Air compressor.... | 978.40 | 642.90 | 0.66 | 791.57 | 0.81 | ..... | ..... |
| 9011.03 | Three dry vacuum pumps..... | 140.00 | 147.26 | 1.05 | 196.78 | 1.42 | 3,337.36 | 23.84 |
| 9011.04 | Three pumps and engines..... | 972.55 | 389.32 | 0.40 | 568.75 | 0.58 | 9,118.69 | 9.38 |
| 9060.02 | Two 5 by 8 vertical triplex pumps... | 113.54 | 176.20 | 1.55 | 195.07 | 1.72 | 2,211.78 | 19.48 |
| | | 11,749.58 | \$6,471.86 | \$0.55 | \$10,763.69 | \$0.92 | \$146,416.33 | \$13.59 |

Group No. 2

| NUMBER | NAME OF ACCOUNT | CWT. | LABOR COST | | ERECTION COST | | TOTAL COST | |
|--------|-------------------------------|----------|------------|----------|---------------|----------|-------------|----------|
| | | | AMOUNT | PER CWT. | AMOUNT | PER CWT. | AMOUNT | PER CWT. |
| 8406 | Two 40-ton Morgan cranes..... | 2,215.00 | \$1,438.50 | \$0.65 | \$3,813.34 | \$1.72 | \$23,027.65 | \$10.40 |
| 8407 | Two clinkering machines..... | 1,692.13 | 1,715.23 | 1.01 | 2,435.73 | 1.44 | 15,697.17 | 9.28 |
| 8415 | Two casting machines. | 2,692.20 | 3,266.34 | 1.21 | 3,682.40 | 1.37 | 27,477.55 | 10.21 |
| | | 6,599.33 | \$6,420.07 | \$0.97 | \$9,931.47 | \$1.50 | \$66,202.37 | \$10.03 |

Group No. 3

| | | | | | | | | |
|---------|---|----------|------------|--------|------------|--------|-------------|---------|
| 7704 | Farrell crusher, 36 by 18..... | 500.00 | 392.86 | 0.79 | 401.31 | 0.80 | 1,486.47 | 2.96 |
| 8112 | Two motor-driven fans at roaster building.. | 61.40 | 77.69 | 1.27 | 81.11 | 1.32 | 1,483.60 | 24.16 |
| 8718 | Traveling hand crane, 5 ton..... | 30.00 | 25.19 | 0.84 | 44.90 | 1.50 | 589.55 | 19.65 |
| 9004 | " 20 ton..... | 252.00 | 131.89 | 0.52 | 169.16 | 0.67 | 1,855.16 | 7.36 |
| 9008.1 | Three surface condensers..... | 1,157.00 | 415.31 | 0.36 | 542.82 | 0.47 | 19,978.86 | 17.27 |
| 9009.03 | One barometric condenser..... | 81.32 | 128.97 | 1.59 | 185.33 | 2.28 | 1,078.65 | 13.26 |
| | | 2,081.72 | \$1,171.91 | \$0.56 | \$1,424.63 | \$0.68 | \$26,472.29 | \$12.72 |

Group No. 4

| | | | | | | | | |
|---------|---|--------|----------|--------|------------|--------|-------------|---------|
| 9011.02 | Two exciters..... | 543.00 | 491.01 | 0.90 | 864.31 | 1.59 | 6,609.27 | 12.17 |
| 9012.02 | Two 150 Kw. synchronous generator sets..... | 418.98 | 319.06 | 0.76 | 699.23 | 1.67 | 7,149.39 | 17.09 |
| | | 961.98 | \$810.07 | \$0.84 | \$1,563.54 | \$1.63 | \$13,758.66 | \$14.30 |

In the above average costs an effort has been made for a logical grouping, yet it is somewhat arbitrary. Group 1 contains the erection of engine machinery. It was here necessary, in addition to handling heavy weights and placing on the foundation, to clean, adjust, and line up many mechanical parts. Group 2 is very similar to 1, but the machinery is not of the engine type and not so heavy in proportion to the labor required to put it in working order. Group 3 composes machinery that required little other labor in the main than the lifting of heavy loads into place. Group 4 is somewhat similar to Group 3, but the labor is principally electrical. The above costs are reported as labor, erection, and total costs. The labor cost is self explanatory. The erection cost is the labor cost plus the needed small supplies, such as waste, oil, small tools, and the like. The total cost is also self-explanatory.

Masonry

| NUMBER | NAME OF ACCOUNT | CU. YD. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|--------|---------------------|---------|------------|-------------|---------------|-------------|------------|-------------|
| | | | AMOUNT | PER CU. YD. | AMOUNT | PER CU. YD. | AMOUNT | PER CU. YD. |
| 7312.2 | Retaining wall..... | 21.9 | \$88.08 | \$4.03 | \$47.51 | \$2.17 | \$135.59 | \$6.19 |

Cost of Painting Concrete

| NUMBER | NAME OF ACCOUNT | SQ. YD. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|---------|---|---------|------------|-------------|---------------|-------------|------------|-------------|
| | | | AMOUNT | PER SQ. YD. | AMOUNT | PER SQ. YD. | AMOUNT | PER SQ. YD. |
| 9002.45 | Power house basement floor.. | 830 | \$81.45 | \$0.10 | \$48.81 | \$0.06 | \$130.26 | \$0.16 |
| | Two coats of Toch cement filler | | | | | | | |
| 9002.7 | Power house walls and foundations..... | 2,459 | 195.84 | 0.08 | 301.61 | 0.12 | 497.45 | 0.20 |
| | One coat of Wadsworth Howland Bay State cement paint | | | | | | | |
| 9003.43 | Power house, top of main floor slab..... | 1,134 | 95.56 | 0.08 | 199.32 | 0.18 | 291.88 | 0.26 |
| | Two coats of Toch cement filler—one coat of Toch cement paint | | | | | | | |

| NUMBER | NAME OF ACCOUNT | Sq. Yd. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|---------|--|---------|------------|-------------|---------------|-------------|------------|-------------|
| | | | AMOUNT | PER Sq. Yd. | AMOUNT | PER Sq. Yd. | AMOUNT | PER Sq. Yd. |
| 8812.30 | Warehouse roof, underside... Two coats white lead and oil | 813 | \$81.16 | \$0.10 | \$65.66 | \$0.08 | \$146.82 | \$0.18 |

| | | | | | | | | |
|---------|--|-------|--------|------|--------|------|----------|--|
| 9003.42 | Power house main floor slab, underside..... | 2,679 | 181.88 | 0.07 | 147.58 | 0.06 | 329.46 | 0.12 |
| .54 | Power house roof, underside.. | 6,813 | 692.84 | 0.10 | 324.55 | 0.05 | 1,017.39 | 0.15 |
| | Two coats white lead and oil | | | | | | | |
| | Square yards derived by developing the Berger plate. | | | | | | | |
| | | | | | | | | This is three times the superficial area |

| NUMBER | NAME OF ACCOUNT | Sq. Yd. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|---------|-------------------|---------|------------|----------------|---------------|----------------|------------|----------------|
| | | | AMOUNT | PER Sq. Yd. | AMOUNT | PER Sq. Yd. | AMOUNT | PER Sq. Yd. |
| 8703.60 | Boiler shop..... | 1,574 | \$92.53 | \$0.05 | \$60.73 | \$0.04 | \$153.26 | \$0.10 |
| 8718.60 | Machine shop..... | 1,989 | 118.00 | 0.06 | 87.40 | 0.04 | 205.40 | 0.10 |
| 8813.10 | Warehouse..... | 412 | 26.50 | 0.06 | 14.17 | 0.03 | 40.67 | 0.10 |
| | | | <hr/> | | <hr/> | | <hr/> | |
| | | 3,975 | \$237.03 | \$0.06 | \$162.30 | \$0.04 | \$399.33 | \$0.10 |

Painting Window Sash and Doors

| NUMBER | NAME OF ACCOUNT | No. OF SASH | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|---------|---------------------------------------|----------------|------------|-------------|---------------|-------------|------------|-------------|
| | | | AMOUNT | PER SASH | AMOUNT | PER SASH | AMOUNT | PER SASH |
| 7803.11 | Sampling plant..... | 129 | \$118.94 | \$0.92 | \$28.96 | \$0.22 | \$147.90 | \$1.14 |
| 8813.11 | Warehouse..... | 189 | 122.78 | 0.65 | 15.34 | 0.08 | 138.12 | 0.73 |
| | Window sash and frames, two-coat work | | | | | | | |
| 9003.60 | Power house..... | 299 | 290.09 | 0.97 | 16.72 | 0.05 | 306.81 | 1.02 |
| | Window sash only, three-coat work | | | | | | | |
| | Doors figured as two sash | | | | | | | |

| NUMBER | NAME OF ACCOUNT | SQUARES | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|----------|--|---------|------------|---------|---------------|---------|------------|---------|
| | | | AMOUNT | PER Sq. | AMOUNT | PER Sq. | AMOUNT | PER Sq. |
| 8703.30 | Boiler and blacksmith shop..... | 66.49 | \$286.52 | \$4.31 | \$828.24 | \$12.46 | \$1,114.76 | \$16.77 |
| 8717.30 | Machine and carpenter shop..... | 77.21 | 297.85 | 3.86 | 953.04 | 12.34 | 1,250.89 | 16.20 |
| | | 143.70 | \$584.37 | \$4.06 | \$1,781.28 | \$12.40 | \$2,365.65 | \$16.46 |
| | Consists of 2 by 8 tongue and groove sheathing, asbestos roofing and nailing strips. No painting included | | | | | | | |
| 8843.4 | Sample room..... | 8.0 | \$23.00 | \$2.88 | \$76.57 | \$9.57 | \$99.57 | \$12.45 |
| | Consists of 1 by 12 sheathing and asbestos roofing. No painting included | | | | | | | |
| 9003.5 | Power house..... | 214.83 | \$3,587.15 | \$16.70 | \$5,791.05 | \$26.96 | \$9,378.20 | \$43.65 |
| | Consists of Berger plate, concrete, tar, and P and B roofing. Painting the underside of the Berger plate is included | | | | | | | |
| 9017.04 | Feed water heating plant | 8.80 | \$115.25 | \$13.10 | 109.88 | \$12.48 | \$225.13 | \$25.58 |
| 9017.25 | Condensed water pump house..... | 5.00 | 73.92 | 14.78 | 60.83 | 12.17 | 134.75 | 26.95 |
| | | 13.80 | \$189.17 | \$13.71 | \$170.71 | \$12.37 | \$359.88 | \$26.08 |
| | Consists of 2 by 8 sheathing with asbestos roofing | | | | | | | |
| 9060.07 | Oil pump house..... | 6.50 | \$136.81 | \$21.05 | \$162.66 | \$25.02 | \$299.47 | \$46.07 |
| | Consists of "hyrib," concrete and plaster | | | | | | | |
| 9060.131 | Oil storage tanks..... | 65.56 | \$761.95 | \$11.62 | \$882.84 | \$13.47 | \$1,644.79 | \$25.09 |
| | Consists of wood supporting structure, 1-in. sheathing and metal lath and plaster | | | | | | | |

Shafting, Pulleys and Belting

| NUMBER | NAME OF ACCOUNT | LIN. FT. OF SHAFTING | | | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|--------|---------------------------------|----------------------|---------|--------|------------|---------|---------------|---------|------------|---------|
| | | AMOUNT | PER FT. | | AMOUNT | PER FT. | AMOUNT | PER FT. | AMOUNT | PER FT. |
| 7804 | Sampling plant..... | 85 | \$64.01 | \$0.75 | \$1,871.07 | \$22.01 | \$1,935.08 | \$22.76 | | |
| 8107 | Roasting plant..... | 164 | 118.24 | 0.72 | 1,999.89 | 12.20 | 2,118.13 | 12.92 | | |
| 8706 | Boiler and blacksmith shop..... | 51 | 105.50 | 2.07 | 301.16 | 5.91 | 406.75 | 7.98 | | |
| 8720 | Machine and carpenter shop..... | 162 | 289.29 | 1.79 | 1,513.36 | 9.34 | 1,802.65 | 11.13 | | |
| 8849.2 | Sample room..... | 26 | 23.30 | 0.89 | 170.17 | 6.55 | 193.56 | 7.44 | | |

Structural Steel

| NUMBER | NAME OF ACCOUNT | AMOUNT | TONS | COST | |
|---------|---|--------------|------------|---------|--|
| | | | | PER TON | |
| 7308.2 | Trestle approach to reverb. building..... | \$13,460.84 | 163.97 | \$82.09 | |
| 7310 | Bridge No. 1..... | 377.40 | 3.70 | 102.00 | |
| 7314 | Trestles to receiving bins..... | 9,269.48 | 109.35 | 84.77 | |
| 7403 | Receiving bins..... | 29,276.63 | 353.09 | 82.92 | |
| 7703 | Crushing plant..... | 2,420.36 | 25.07 | 96.54 | |
| 7803 | Sampling plant..... | 10,408.12 | 110.85 | 93.89 | |
| 7903 | Bodding plant..... | 47,404.86 | 548.71 | 86.39 | |
| 8103 | Roasting plant..... | 37,252.67 | 445.28 | 83.66 | |
| 8123 | Roaster dust chamber..... | 34,745.41 | 415.68 | 83.59 | |
| 8303 | Reverberatory plant..... | 40,799.76 | 461.09 | 88.48 | |
| 8306.2 | Flues from boilers to reverb. flue..... | 2,815.32 | 34.78 | 80.95 | |
| 8308 | Boiler building..... | 25,839.85 | 292.03 | 88.48 | |
| 8403 | Converter plant..... | 69,359.60 | 783.86 | 88.48 | |
| 8423 | Converter dust chamber..... | 20,371.20 | 238.30 | 85.49 | |
| 8503 | Conveying system..... | 19,365.98 | 211.73 | 91.47 | |
| 8614 | Reverberatory flue..... | 3,593.06 | 41.61 | 86.35 | |
| 8624 | Converter flue..... | 6,616.44 | 81.99 | 80.70 | |
| 8629 | Roaster dust chamber flue..... | 9,209.36 | 94.46 | 97.49 | |
| 8703 | Boiler and blacksmith shop..... | 2,913.90 | 32.72 | 89.06 | |
| 8717 | Machine and carpenter shop..... | 3,431.42 | 38.23 | 89.76 | |
| 8812 | Warehouse..... | 3,734.08 | 39.76 | 93.92 | |
| 9003 | Power house..... | 23,773.13 | 254.29 | 93.49 | |
| 9014.02 | North and south mains..... | 7,694.58 | 86.81 | 88.64 | |
| 9017.02 | Feed water heating plant..... | 2,262.90 | 26.63 | 84.98 | |
| Total | | \$426,396.35 | \$4,839.99 | \$87.13 | |

Tile Walls

| NUMBER | NAME OF ACCOUNT | CU. FT. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|------------|---------------------------------|---------|-------------|-------------|---------------|-------------|-------------|-------------|
| | | | AMOUNT | PER CU. FT. | AMOUNT | PER CU. FT. | AMOUNT | PER CU. FT. |
| 8106.02 | Roaster flues..... | 2,365 | \$374.82 | \$0.16 | \$400.36 | \$0.17 | \$775.18 | \$0.33 |
| 8123.10 | Roaster dust chamber..... | 14,980 | 2,268.20 | 0.15 | 2,585.45 | 0.17 | 4,853.74 | 0.32 |
| 8423.10 | Converter dust chamber..... | 6,369 | 1,620.05 | 0.25 | 2,182.40 | 0.34 | 3,802.45 | 0.60 |
| 8613 | Reverberatory flue.... | 6,400 | 1,272.86 | 0.20 | 1,696.39 | 0.26 | 2,969.25 | 0.46 |
| 8628 | Roaster dust chamber flue..... | 4,231 | 1,018.13 | 0.24 | 1,573.06 | 0.37 | 2,591.19 | 0.61 |
| 8703.20 | Boiler and blacksmith shop..... | 2,297 | 477.95 | 0.21 | 612.62 | 0.27 | 1,090.57 | 0.48 |
| 8717.20 | Machine and carpenter shop..... | 2,397 | 531.45 | 0.22 | 571.28 | 0.24 | 1,102.73 | 0.46 |
| 8812.20 | Warehouse..... | 2,342 | 438.00 | 0.19 | 477.86 | 0.20 | 915.86 | 0.39 |
| 9003.10 | Power house..... | 14,343 | 3,856.83 | 0.26 | 4,510.20 | 0.31 | 8,367.03 | 0.58 |
| 9017.03 | Feed water heating plant..... | 706 | 285.99 | 0.41 | 234.36 | 0.33 | 520.35 | 0.74 |
| 9017.242 | Condensed water pump house..... | 257 | 98.87 | 0.38 | 84.28 | 0.33 | 183.15 | 0.71 |
| Total..... | | 56,687 | \$12,243.24 | \$0.22 | \$14,928.26 | \$0.26 | \$27,171.50 | \$0.48 |

Unloading Brick and Tile

| NUMBER | NAME OF ACCOUNT | TOTAL COST | TONS | COST PER TON |
|------------|---------------------------------|------------|----------|--------------|
| 8105.01 | Roaster brick..... | \$363.14 | 1,231.01 | \$0.21 |
| 8123.11 | Roaster dust chamber tile..... | 307.72 | 525.05 | 0.58 |
| 8304.01 | Reverberatory furnaces..... | 1,264.49 | 2,279.49 | 0.55 |
| 8305.01 | Cross and header flue..... | 497.60 | 1,329.23 | 0.37 |
| 8309.02 | Waste heat boilers..... | 518.91 | 1,073.74 | 0.48 |
| 8309.12 | Oil-fired boilers..... | 183.94 | 228.11 | 0.81 |
| 8405.11 | Converters..... | 186.25 | 579.30 | 0.32 |
| 8423.11 | Converter dust chamber..... | 37.61 | 155.20 | 0.24 |
| 8613.01 | Reverberatory flue..... | 57.79 | 278.33 | 0.21 |
| 8628.01 | Roaster dust chamber flue..... | 57.60 | 171.40 | 0.34 |
| 8703.21 | Boiler and blacksmith shop..... | 18.89 | 69.70 | 0.27 |
| 8717.21 | Machine and carpenter shop..... | 44.06 | 58.80 | 0.75 |
| 8812.21 | Warehouse..... | 16.50 | 74.20 | 0.22 |
| 9003.11 | Power plant..... | 332.57 | 522.70 | 0.64 |
| 9017.031 | Feed water heating plant..... | 24.91 | 30.00 | 0.83 |
| Total..... | | \$3,911.98 | 8,606.26 | \$0.45 |

These costs cover such costs as cleaning the site for unloading, building runways where needed, constructing brick sheds, and checking the quantities of the shipment, as well as the unloading of the various shapes in separate piles.

Ventilators

| NUMBER | NAME OF ACCOUNT | No. OF VENTI- LATORS | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|----------|--|----------------------------|------------|-------------|---------------|-------------|------------|-------------|
| | | | AMOUNT | PER VENT | AMOUNT | PER VENT | AMOUNT | PER VENT |
| 8703.31 | Boiler and blacksmith shop..... | 3 | \$16.01 | \$5.33 | \$261.50 | \$87.17 | \$277.51 | \$92.50 |
| 8717.31 | Machine and carpenter shop..... | 3 | 11.16 | 3.72 | 248.24 | 82.74 | 259.40 | 86.46 |
| | | 6 | \$27.17 | \$4.53 | \$509.74 | \$84.96 | \$536.91 | \$89.49 |
| | 48-in. Burt ventilators, square base, set on wooden roof | | | | | | | |
| 8812.31 | Warehouse..... | 3 | \$30.38 | \$10.13 | \$207.12 | \$69.04 | \$237.50 | \$79.17 |
| | 48-in. Burt ventilators, round base, set on corrugated iron roof | | | | | | | |
| 9003.3 | Power house..... | 6 | \$125.60 | \$20.94 | \$439.76 | \$73.29 | \$565.36 | \$94.23 |
| | 48-in. Burt ventilators, square base, set on concrete roof | | | | | | | |
| 9017.045 | Feed water heating plant..... | 2 | \$142.14 | \$71.07 | \$49.20 | \$21.60 | \$191.34 | \$95.67 |
| | 42-in. ventilators made in new smelter shops, set on wooden roof | | | | | | | |

Windows and Doors

| NUMBER | NAME OF ACCOUNT | Sq. Ft. OPEN- ING | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|--------|---|-------------------------|------------|----------------|---------------|----------------|------------|----------------|
| | | | AMOUNT | PER Sq. Ft. | AMOUNT | PER Sq. Ft. | AMOUNT | PER Sq. Ft. |
| 7703.1 | Crushing plant..... | 529 | \$84.00 | \$0.16 | \$170.71 | \$0.32 | \$254.71 | \$0.48 |
| 7803.1 | Sampling plant..... | 2,086 | 332.94 | 0.16 | 564.90 | 0.27 | 897.84 | 0.43 |
| | | 2,615 | \$416.94 | \$0.16 | \$735.61 | \$0.26 | \$1,152.55 | \$0.44 |
| 8843.5 | The above accounts cover wooden sash and frame set in steel and corrugated iron building | | | | | | | |
| | Sample room..... | 298 | \$32.39 | \$0.11 | \$118.85 | \$0.40 | \$151.24 | \$0.51 |
| | The above account covers wooden sash and frame set in wood and corrugated iron building | | | | | | | |
| 8703.1 | Boiler and blacksmith shop..... | 2,581 | \$693.02 | \$0.27 | \$2,456.28 | \$0.95 | \$3,149.30 | \$1.22 |
| 8717.1 | Machine and carpenter shop..... | 3,037 | 923.61 | 0.30 | 2,992.16 | 0.99 | 3,915.77 | 1.29 |
| | | 5,618 | \$1,616.63 | \$0.29 | \$5,448.44 | 0.97 | \$7,065.07 | \$1.26 |
| | The above accounts cover steel sash and frame set in steel and tile curtain wall building | | | | | | | |

Windows and Doors (Continued)

| NUMBER | NAME OF ACCOUNT | Sq. Ft. OPEN- ING | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|----------|--|-------------------------|------------|----------------|---------------|----------------|------------|----------------|
| | | | AMOUNT | PER Sq. Ft. | AMOUNT | PER Sq. Ft. | AMOUNT | PER Sq. Ft. |
| 8812.1 | Warehouse..... | 1,982 | \$533.02 | \$0.27 | \$1,056.31 | \$0.53 | \$1,589.33 | \$0.80 |
| 8822.5 | Laboratory..... | 823 | 208.70 | 0.25 | 480.33 | 0.59 | 689.03 | 0.81 |
| 9017.035 | Heater house..... | 186 | 59.83 | 0.32 | 99.98 | 0.54 | 159.81 | 0.86 |
| 9017.24 | Cond. water pump house. | 57 | 26.02 | 0.45 | 22.68 | 0.40 | 48.70 | 0.85 |
| | | 3,048 | \$827.57 | \$0.27 | \$1,659.30 | \$0.54 | \$2,486.87 | \$0.81 |
| | The above account covers wooden sash and frame set in steel and tile curtain wall building | | | | | | | |
| 9060.06 | Oil pump house..... | 124 | \$83.60 | \$0.68 | \$65.02 | \$0.52 | \$148.62 | \$1.20 |
| | The above account covers wooden sash and frame set in concrete walls | | | | | | | |
| 9003.2 | Power house..... | 4,044 | \$974.38 | \$0.24 | \$3,319.93 | \$0.82 | \$4,294.31 | \$1.06 |
| | The above account covers steel frame and wooden sash set in steel and tile curtain wall building | | | | | | | |

Wire Baffles

| NUMBER | NAME OF ACCOUNT | C. WIRES | LABOR COST | | MATERIAL COST | | TOTAL COST | | |
|---------|------------------------|----------|------------|--------------|---------------|--------------|------------|--------------|--------|
| | | | AMOUNT | PER C. WIRES | AMOUNT | PER C. WIRES | AMOUNT | PER C. WIRES | |
| 8123.01 | Roaster dust chamber.. | 604.80 | \$523.63 | \$0.87 | \$1,758.23 | \$7.87 | \$5,281.86 | \$8.73 | |
| 8423.01 | Converter dust chamber | 166.10 | 138.86 | 0.84 | 1,101.95 | 6.63 | 1,240.81 | 7.47 | |
| | | | | | | | | | |
| | | | \$770.90 | \$662.49 | \$0.86 | \$5,860.18 | \$7.66 | \$6,522.67 | \$8.16 |

Woodwork

| NUMBER | NAME OF ACCOUNT | M.B.M. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|---------|--|--------|------------|---------------|---------------|---------------|------------|---------------|
| | | | AMOUNT | PER M.B.M. | AMOUNT | PER M.B.M. | AMOUNT | PER M.B.M. |
| 7308.3 | Trestle approach to reverh. bldg..... | 27.65 | \$703.93 | \$25.45 | \$768.92 | \$27.81 | \$1,472.85 | \$53.27 |
| 7314.3 | Trestle to receiving bins..... | 27.21 | 572.23 | 21.03 | 838.11 | 30.80 | 1,410.34 | 51.83 |
| | | 54.86 | \$1,276.16 | \$23.26 | \$1,607.03 | \$29.29 | \$2,883.19 | \$52.55 |
| 9052 | Cooling tower..... | 128.63 | 3,181.33 | 24.73 | 5,415.47 | 42.10 | 8,596.80 | 66.84 |
| 9060.16 | Track bumpers..... | 3.16 | 216.74 | 78.08 | 47.92 | 15.16 | 264.66 | 93.25 |

Wooden Floors

| NUMBER | NAME OF ACCOUNT | Sq. Ft. | LABOR COST | | MATERIAL COST | | TOTAL COST | |
|---------|-----------------------------|---------|------------|----------------|---------------|----------------|------------|----------------|
| | | | AMOUNT | PER Sq. Ft. | AMOUNT | PER Sq. Ft. | AMOUNT | PER Sq. Ft. |
| 8717.40 | Machine and carpenter shop. | 4,136 | \$269.80 | \$0.07 | \$593.30 | \$0.14 | \$863.10 | \$0.21 |
| | See sketch No. 24 | | | | | | | |

CHAPTER III

COMPOSITE COSTS

Cost of Building per Square Foot of Floor Space

| NUMBER | NAME OF ACCOUNT | Sq. Ft. OF FLOOR SPACE | TOTAL COST | |
|--------|--|---------------------------|------------|-------------|
| | | | AMOUNT | PER Sq. Ft. |
| 7700 | Crushing plant..... | 1,650 | \$5,968.32 | \$3.62 |
| | Includes accounts 7701 to 7703.2 inclusive and 7707.1 | | | |
| 7800 | Sampling plant..... | 6,140 | 16,299.16 | 2.65 |
| | Includes accounts 7801 to 7803.11 inclusive, 7806.1 and 7809 | | | |
| 8100 | Roasting plant..... | 28,740 | 43,322.75 | 1.51 |
| | Includes accounts 8101 to 8103.1 inclusive, and 8109 | | | |
| 8300 | Reverberatory plant..... | 20,370 | 50,687.28 | 2.49 |
| | Includes accounts 8301 (\$784 32,) 8302 (\$8,560.45), 8303 and one-half of 8313.1 | | | |
| 8307 | Reverberatory boiler building..... | 14,310 | 36,887.67 | 2.58 |
| | Includes accounts 8307; 0.04; 0.1; 0.2; 0.3; 8308, one-half of 8313.1 | | | |
| 8400 | Converter building..... | 26,084 | 87,231.14 | 3.34 |
| | Includes accounts 8401, 8402, 8403, 8409.1, 8413, 8414, 8416, 8416.1, 8416.11 and 8416.2 | | | |
| 8700 | Boiler and blacksmith shop..... | 4,424 | 11,320.58 | 2.56 |
| | Includes accounts 8701 to 8703.40 inclusive, 8703.60 and 8708 | | | |
| 8714 | Machine and carpenter shop..... | 5,144 | 14,905.56 | 2.90 |
| | Includes accounts 8714 to 8717.50 inclusive; 8717.60 and 8722 | | | |
| 8809 | Warehouse..... | 5,040 | 11,512.93 | 2.28 |
| | Includes accounts 8810 to 8812.50 inclusive; 8813.10 and 8813.11 | | | |
| 8819 | Laboratory..... | 1,492 | 11,363.77 | 2.92 |
| | Includes accounts 8820 to 8822.5 inclusive; 8825, 8828 and 8829 | | | |
| 8840 | Sample room..... | 600 | 991.46 | 1.65 |
| | Includes accounts 8841 to 8843.5 inclusive; 8846 and 8848 | | | |
| 9000 | Power plant..... | 32,096 | 77,452.56 | 2.41 |
| | Includes accounts 9001 to 9003.61 inclusive, excluding 9002.2 | | | |

Cost of Buildings per Cubic Foot

| NUMBER | NAME OF ACCOUNT | Cu. Ft. IN BUILDING | TOTAL COST | |
|--------|------------------------------------|------------------------|------------|-------------|
| | | | AMOUNT | PER Cu. Ft. |
| 7700 | Crushing plant..... | 27,040 | \$5,968.32 | \$0.22 |
| 7800 | Sampling plant..... | 80,547 | 16,299.16 | 0.20 |
| 8100 | Roasting plant..... | 410,140 | 43,322.75 | 0.11 |
| 8300 | Reverberatory plant..... | 474,350 | 50,687.28 | 0.11 |
| 8307 | Reverberatory boiler building..... | 500,850 | 36,887.67 | 0.07 |
| 8400 | Converter building..... | 1,529,636 | 87,231.14 | 0.06 |
| 8700 | Boiler and blacksmith shop..... | 86,268 | 11,320.58 | 0.15 |
| 8714 | Machine and carpenter shop..... | 100,308 | 14,905.56 | 0.15 |
| 8809 | Warehouse..... | 83,160 | 11,512.93 | 0.14 |
| 8819 | Laboratory..... | 16,140 | 4,363.77 | 0.27 |
| 8840 | Sample room..... | 6,000 | 991.46 | 0.16 |
| 9000 | Power house..... | 784,000 | 77,452.56 | 0.10 |

In the above costs the same account numbers are used as in computing the cost of buildings per square foot of floor space.

Cost of Buildings Equipped Per Square Foot of Floor Space

| NUMBER | NAME OF ACCOUNT | Sq. Ft. OF FLOOR SPACE | TOTAL COST | |
|--------|---|---------------------------|------------|--------------|
| | | | AMOUNT | PER Sq. Ft., |
| 7700 | Crushing plant..... | 1,650 | \$9,268.62 | \$5.62 |
| | Accounts 7701 to 7707.1 inclusive | | | |
| 7800 | Sampling plant..... | 6,140 | 34,108.74 | 5.56 |
| | Accounts 7801 to 7810 inclusive | | | |
| 8100 | Roasting plant..... | 28,740 | 136,734.87 | 4.76 |
| | Accounts 8101 to 8113.2 inclusive | | | |
| 8300 | Reverberatory plant..... | 20,370 | 172,171.55 | 8.45 |
| | Accounts 8301 to 8305.2 inc.—8307.2, 8312 and 8313, deducting one-half of each 8314 8315 and 8318—8316, deducting two-thirds of this account | | | |
| 8307 | Reverberatory boiler building..... | 14,310 | 159,716.26 | 11.16 |
| | Accounts 8306 to 8317.2 inc. deducting one-half of 8307.2, 8312 and 8313.1, and two-thirds of 8316 | | | |
| 8400 | Converter building..... | 26,084 | 216,033.37 | 8.28 |
| | Accounts 8401 to 8419.4 and 8425 to 8426.4 inclusive | | | |
| 8700 | Boiler shop..... | 4,424 | 21,449.23 | 4.85 |
| | Accounts 8701 to 8708 inclusive | | | |
| 8714 | Machine and carpenter shop..... | 5,144 | 27,356.27 | 5.32 |
| | Accounts 8715 to 8722 inclusive | | | |
| 8809 | Warehouse..... | 5,040 | 13,602.71 | 2.70 |
| | Accounts 8810 to 8813.11 inclusive | | | |
| 8819 | Laboratory..... | 1,492 | 6,144.02 | 4.12 |
| | Accounts 8820 to 8831 inclusive | | | |
| 8840 | Sample room..... | 600 | 2,826.11 | 4.71 |
| | Accounts 8841 to 8849.2 inclusive | | | |
| 9000 | Power house..... | 32,096 | 359,590.10 | 11.20 |
| | Accounts 9001 to 9004 and 9006.01 to 9016.01 inclusive, deducting one-half of 9014 to 9014.05 inclusive. | | | |

Cost of Buildings Equipped per Cubic Foot.

| NUMBER | NAME OF ACCOUNT | Sq. Ft. OF FLOOR SPACE | TOTAL COST | |
|--------|------------------------------------|---------------------------|------------|--------------|
| | | | AMOUNT | PER Sq. Ft., |
| 7700 | Crushing plant..... | 27,040 | \$9,268.62 | \$0.34 |
| 7800 | Sampling plant..... | 80,547 | 34,108.74 | 0.42 |
| 8100 | Roasting plant..... | 410,140 | 136,734.87 | 0.33 |
| 8300 | Reverberatory plant..... | 474,350 | 172,171.55 | 0.36 |
| 8307 | Reverberatory boiler building..... | 500,850 | 159,716.26 | 0.32 |
| 8400 | Converter building..... | 1,529,636 | 216,033.37 | 0.14 |
| 8700 | Boiler and blacksmith shop..... | 86,286 | 21,449.23 | 0.24 |
| 8714 | Machine and carpenter shop..... | 100,308 | 27,356.27 | 0.27 |
| 8809 | Warehouse..... | 83,160 | 13,602.71 | 0.16 |
| 8819 | Laboratory..... | 16,140 | 6,144.02 | 0.38 |
| 8840 | Sample room..... | 6,000 | 2,826.11 | 0.47 |
| 9000 | Power house..... | 784,000 | 359,590.10 | 0.46 |

The amounts shown above are the same as those used in the cost of buildings equipped per square foot

Bedding Plant and Bunker Bins. Cost per Cubic Foot of Capacity of both Beds and Bins

| CAPACITY | | TOTAL COST | |
|---------------------|--|--------------|--------------|
| | | AMOUNT | PER Cu. Ft., |
| 228,440 cu. ft..... | | \$150,939.05 | \$0.66 |

This cost consists of accounts 7901 to 7908 inclusive

The capacity was obtained by actual measurement

Three Spreading Beds. Cost per Cubic Foot of Capacity

| CAPACITY | | TOTAL COST | |
|---------------------|--|--------------|--------------|
| | | AMOUNT | PER Cu. Ft., |
| 160,380 cu. ft..... | | \$120,177.94 | \$0.75 |

This is partly as estimated cost. It was obtained by deducting the cost of the bunker bins installation from the total bedding plant, and substituting therefor such excavation, foundation, steel work, etc., as would be necessary to provide for conveyors 7 and 10

Receiving Bins—Cost per Cubic Foot of Capacity

| CAPACITY | TOTAL COST | |
|---------------------|-------------|-------------|
| | AMOUNT | PER CU. FT. |
| 11,386 cu. ft. | \$38,073.73 | \$3.34 |

This cost consists of accounts 7401 to 7404 inclusive, and 7407
The capacity of the receiving bins was obtained by assuming that the material lay on a one and one-half to one slope on falling from the cars

Conveyors—Cost per Ton of Capacity

| CONVEYORS | CAPACITY, TONS PER HOUR | TOTAL COST | | |
|--|----------------------------|------------|---------|--------------|
| | | AMOUNT | PER TON | |
| No. 1..... | 100 | \$3,258.11 | \$32.58 | Account 7405 |
| " 2..... | 150 | 2,853.22 | 19.02 | " 7405.01 |
| " 7 ¹ -7 ² | 250 | 6,938.01 | 27.75 | " 7904 |
| " 8 ¹ -8 ² -8 ³ | 450 | 9,929.99 | 22.07 | " 7904.1 |
| " 9 ¹ -9 ² -9 ³ -10 ¹ -10 ² | 500 | 11,668.39 | 23.33 | " 7904.2 |
| " 12..... | 100 | 969.20 | 9.69 | " 8113 |
| " 13 ¹ -13 ² | 200 | 3,948.62 | 19.74 | " 8113.1 |
| " 15..... | 100 | 2,674.24 | 26.74 | " 8425 |
| " 3-4-5-6-11-14..... | 700 | 13,716.49 | 19.59 | " 8505 |

The above costs do not include any steel supporting structure for the conveyors. Capacities are taken from the designers' drawings

Complete Conveyor—Cost per Lineal Foot

| CONVEYOR No. | TOTAL LENGTH | AMOUNT | COST PER FOOT |
|-----------------------------|--------------|-------------|---------------|
| No. 3, 4, 5, 6, 11, 14..... | 1,284.9 ft. | \$44,290.65 | \$34.47 |

Cost consists of accounts 8501 to 8505.2, and 8506. The total length is the sum of the lengths of the various conveyors measured from center of head pulley to center of tail pulley

Cost of Cooling Tower per Thousand Gallons a Minute

| M GALLONS PER MIN. | TOTAL COST | |
|--------------------|-------------|---------------|
| | AMOUNT | PER M GALLONS |
| 12 M..... | \$26,273.01 | \$2,189.42 |

Cost consists of accounts 9050 to 9053 inclusive

Cost of Dust Chambers per Cubic Foot

| NAME | CU. FT. | TOTAL COST | | |
|-----------------------------|---------|-------------|-------------|-----------------------------------|
| | | AMOUNT | PER CU. FT. | |
| Roaster dust chamber..... | 256,860 | \$49,664.76 | \$0.19 | Accounts 8121 to 8123.3 inclusive |
| Converter dust chamber..... | 67,210 | 27,813.58 | 0.41 | " 8421 to 8428 " |

Cost of Flues per Cubic Foot

| NAME | CU. FT. | TOTAL COST | | |
|--|---------|-------------|-------------|-----------------------------------|
| | | AMOUNT | PER CU. FT. | |
| Reverberatory flue..... | 63,420 | \$13,453.70 | \$0.21 | Accounts 8611 to 8614.2 inclusive |
| Roaster dust chamber flue..... | 29,527 | 12,859.10 | 0.44 | " 8625 to 8629 " |
| Flues from boilers to reverb. flues..... | 6,734 | 2,983.42 | 0.44 | " 8306 to 8306.2 " |
| Converter flue..... | 10,705 | 7,602.88 | 0.71 | " 8621 to 8624 " |

Cost of Flues per Lineal Foot

| NAME | LIN. FT. | TOTAL COST | | |
|-----------------------------------|----------|-------------|---------|---|
| | | AMOUNT | PER FT. | |
| Reverb. flue..... | 250 | \$13,453.70 | \$53.81 | In obtaining these costs the same accounts were used as in computing the cost of flue per cubic foot. |
| Roaster dust chamber flue..... | 170 | 12,859.10 | 75.64 | |
| Flues from boilers to reverb. ... | 246 | 2,983.42 | 12.13 | |
| Converter flue..... | 208 | 7,602.88 | 36.55 | |

Total Cost

Cost consists of accounts 8306 to 8313.1 inclusive—deducting one-half of 8307.2, 8312 and 8313.1
8316 to 8317.2 inclusive—deducting two-thirds of 8316, 9001 to 9004 inclusive, 9006.01 to 905.3
inclusive, 9060.20 to 9060.23 inclusive—deducting three-fourths of these accounts.

| | |
|-------------------------|---------|
| | 1.11 P. |
| 3 turbines..... | 9,160 |
| 2 Nordberg blowers..... | 1,000 |
| 1 air compressor..... | 200 |

Total..... 10,300

FORM 60-4

Cost consists of accounts 9001 to 9004 inclusive, 9006.01 to 9016.02 inclusive deducting one-half of 9014 to 9014.05, 9017.20 to 9017.27 inclusive, 9018.1 to 9022 inclusive, 903.1 to 905.1 inclusive.

TOTAL COVER

Cost consists of accounts 8300 to 8313.1 inclusive - deducting one-half of 8307.2, 8312 and 8313.1; 8316 to 8317.2 inclusive - deducting two-thirds of 8316, 9014 to 9011.05 inclusive - deducting one-half of these accounts, 9017 to 9017.15 inclusive, 9060.20 to 9060.23 - deducting three-quarters of these accounts.

| | |
|---------------------------|-------|
| 7 waste heat (a) 713..... | 1,091 |
| 3 oil-fired (a) 384..... | 1,152 |

| | |
|-------------------------------|-------|
| Total boiler horse power..... | 6,111 |
|-------------------------------|-------|

FINAL COVER

Cost includes accounts 8301 to 8305.2 inclusive, 8307.2, 8312, 8313.1 (one-half of each) 8314, 8315, and 8318. 8316 (two-thirds). 3 reverberatories at 400 tons per 24 hr. capacity

‘Tutut, Tutut’

| | | |
|---|--------------|--------------|
| Cost consists of accounts 8101 to 8113.2—Roaster building and roasters | | |
| 8..... | \$199,258.73 | \$21,967.34 |
| Cost consists of accounts 8101 to 8113.2 inclusive—Roaster building and roasters. | | |
| inclusive—Roaster dust chamber. 8626 to 8629 inclusive—Roaster dust chamber flue | | \$121,081.34 |

LABOR COST

This cost consists of accounts 7301 to 7305 inclusive. The 697 ft. of track which was on trestles was deducted from account 7303.

CHAPTER IV

WAGE SCALE

| OCCUPATION | FEB. 28, 1912, TEN HOURS | | APRIL 1, 1912, NINE HOURS | | JULY 24, 1912, NINE HOURS | | JULY 1, 1913, NINE HOURS | | SEPT. 1, 1913a, FOUR HOUR | |
|------------------------|-----------------------------|--------|------------------------------|-------|------------------------------|-------|-----------------------------|-------|------------------------------|-------|
| | A. | M. | A. | M. | A. | M. | A. | M. | A. | M. |
| Blacksmiths..... | | \$2 50 | \$4 00 | ..... | \$4 50 | ..... | \$4 50 | ..... | \$4 25 | ..... |
| “ helpers..... |  | ..... | ..... | 2 25 | 3 00 | 3 00 | 2 50 | 2 50 | 4 50 | ..... |
| Boilermaker boss..... |  | ..... | ..... | ..... | ..... | ..... | 3 00 | 3 00 | 2 50 | 2 25 |
| Boilermakers..... |  | ..... | ..... | ..... | 4 50 | ..... | 5 50 | ..... | 3 25 | 3 00 |
| “ “ layer-out |  | ..... | ..... | ..... | ..... | ..... | 4 50 | ..... | 5 50 | ..... |
| “ “ helpers..... |  | ..... | ..... | ..... | 3 00 | ..... | 4 75 | ..... | 4 25 | ..... |
| Brick masons..... |  | ..... | ..... | ..... | ..... | ..... | 3 00 | 3 00 | 3 00 | 3 00 |
| “ tenders..... |  | ..... | ..... | ..... | ..... | ..... | 36 50 | ..... | 36 50 | 25 |
| Carpenter boss..... |  | ..... | ..... | ..... | 5 00 | ..... | 5 00 | ..... | 5 00 | ..... |
| “ 1st class..... | 4 50 | ..... | 4 00 | ..... | 4 50 | ..... | 4 50 | ..... | 4 25 | ..... |
| “ 2nd class..... | 4 00 | 4 00 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| “ helpers..... | 3 00 | 3 00 | 3 00 | 3 00 | 3 00 | ..... | 3 00 | ..... | 2 50 | ..... |
| “ (with tools).... | ..... | ..... | ..... | ..... | 3 50 | ..... | 3 50 | ..... | 3 00 | ..... |
| “ helpers..... | ..... | ..... | ..... | 2 25 | ..... | ..... | ..... | ..... | ..... | ..... |
| Cart drivers..... | ..... | ..... | ..... | ..... | 2 25 | 2 25 | ..... | ..... | ..... | ..... |
| Cement finisher boss.. | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 5 00 | ..... |
| “ “ “..... | ..... | ..... | ..... | ..... | 4 50 | ..... | ..... | 2 50 | ..... | ..... |
| “ “ “..... | ..... | ..... | ..... | ..... | ..... | ..... | 3 50 | 3 50 | ..... | ..... |
| Concrete boss..... | ..... | ..... | ..... | ..... | 4 50 | ..... | 4 50 | 4 00 | ..... | ..... |
| “ mixers..... | ..... | ..... | ..... | 2 25 | ..... | 2 25 | ..... | 2 25 | ..... | ..... |
| Corral boss..... | ..... | ..... | 3 50 | ..... | 3 50 | ..... | 3 50 | ..... | 3 50 | ..... |
| “ men..... | ..... | ..... | ..... | ..... | 2 25 | 2 25 | ..... | ..... | ..... | ..... |
| Drillers..... | ..... | 2 25 | ..... | 2 00 | ..... | ..... | ..... | ..... | ..... | ..... |
| Electrician boss..... | ..... | ..... | ..... | ..... | ..... | ..... | 5 00 | ..... | 4 50 | ..... |
| Electrician..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 5 00 | ..... |
| “ helpers..... | ..... | ..... | ..... | ..... | ..... | ..... | 4 50 | ..... | 4 25 | ..... |
| Engineers, locomotive | 3 25 | ..... | ..... | ..... | ..... | ..... | 3 00 | 2 25 | 2 75 | ..... |
| “ compressors..... | ..... | ..... | ..... | ..... | 3 50 | ..... | ..... | ..... | 3 00 | ..... |
| “ stationary..... | ..... | ..... | ..... | ..... | 3 00 | ..... | 3 50 | ..... | 3 50 | ..... |
| Janitors..... | ..... | ..... | ..... | 2 00 | ..... | 2 25 | ..... | ..... | ..... | ..... |
| Labor bosses..... | ..... | ..... | 3 25 | 2 00 | 4 00 | ..... | 4 00 | ..... | 4 00 | ..... |
| “ “ “..... | ..... | ..... | 4 00 | 2 50 | ..... | ..... | 4 50 | ..... | ..... | ..... |
| “ “ “..... | ..... | ..... | ..... | 3 00 | ..... | ..... | ..... | ..... | ..... | ..... |
| Laborers..... | 1 75 | ..... | 1 75 | ..... | 2 00 | ..... | 2 00 | ..... | 1 75 | ..... |
| Machine shop boss..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 00 |
| “ “ “..... | ..... | ..... | ..... | ..... | ..... | ..... | 5 00 | ..... | 5 00 | ..... |
| (outside)..... | ..... | ..... | ..... | ..... | ..... | ..... | 5 50 | ..... | ..... | ..... |
| Machinist..... | ..... | ..... | 4 00 | ..... | 4 50 | ..... | 4 50 | ..... | 4 25 | ..... |
| “ helpers..... | ..... | ..... | 3 00 | ..... | 3 00 | 3 00 | 3 00 | 2 50 | 3 00 | 3 00 |
| Minors, underground. | ..... | ..... | ..... | 12 75 | ..... | 2 75 | ..... | ..... | ..... | ..... |
| “ surface..... | ..... | ..... | ..... | 2 25 | ..... | 2 25 | ..... | ..... | ..... | ..... |
| Office boys..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 00 | ..... | 12 00 |
| Pipe fitter boss..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 25 |
| Pipe fitter..... | 2 50 | ..... | ..... | ..... | ..... | ..... | 5 50 | ..... | 5 50 | ..... |
| “ “ helpers..... | ..... | ..... | ..... | ..... | ..... | ..... | 4 50 | ..... | 4 25 | ..... |
| “ “ “..... | ..... | ..... | ..... | ..... | ..... | ..... | 3 00 | 2 25 | 3 00 | ..... |

A—American.

M—Mexican.

† Eight hours.

‡ Nine hours.

Wage Scale

| OCCUPATION | FEB. 28, 1912, TEN HOURS | APRIL 1, 1912, NINE HOURS | JULY 24, 1912, NINE HOURS | JULY 1, 1913, NINE HOURS | SEPT. 1, 1913, EIGHT HOURS |
|---------------------------------|-----------------------------|------------------------------|------------------------------|-----------------------------|-------------------------------|
| Plow holders..... | | 2.25 | 2.25 | | |
| Plumbers..... | | | 4.50 | | |
| “ helpers..... | | | 3.00 | | |
| Rigger boss..... | | 4.50 | 5.00 | | |
| Rigger..... | | | | 3.50 | 4.25 |
| “ helpers..... | | 2.25 | 2.25 | 4.50 | |
| | | | | 2.25 | 2.25 |
| | | | | 2.50 | 2.50 |
| | | | | 3.00 | 3.00 |
| Stone mason boss..... | | | 3.50 | | |
| “ “..... | 3.00 | | 3.00 | 3.00 | |
| Steam fitters..... | | | 4.50 | | |
| “ helpers..... | | | 3.00 | | |
| Teamsters. 4 and 6 head..... | | 3.00 | | 3.00 | |
| “ 2 head..... | | 2.00 | 2.00 | 2.25 | 2.25 |
| “ fresnos and slips. | 2.25 | 2.25 | 2.00 | 2.00 | 2.50 |
| “ plow..... | 2.75 | | 2.25 | 2.25 | |
| Tinners..... | | | | 4.00 | 4.50 |
| “ helpers..... | | | | 2.50 | 2.50 |
| Tool room man..... | | | 2.00 | 2.25 | |
| Tool sharpeners..... | | | 3.50 | 4.00 | |
| Track boss..... | | | 4.25 | | |
| Water boys..... | 1.30 | | 1.00 | 2.00 | 2.00 |
| Warehouse help..... | | | | 3.00 | 2.50 |
| | | | | | 3.00 |

CHAPTER V

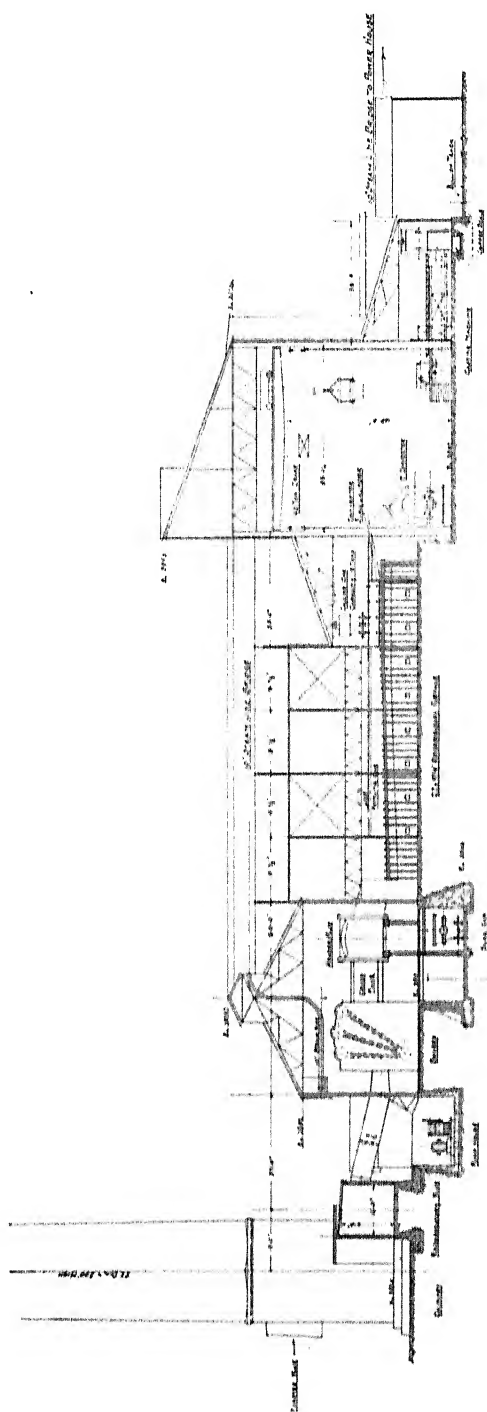
RAW MATERIAL PRICES

Prices of Raw Material F. O. B. Clifton During New Smelter Construction

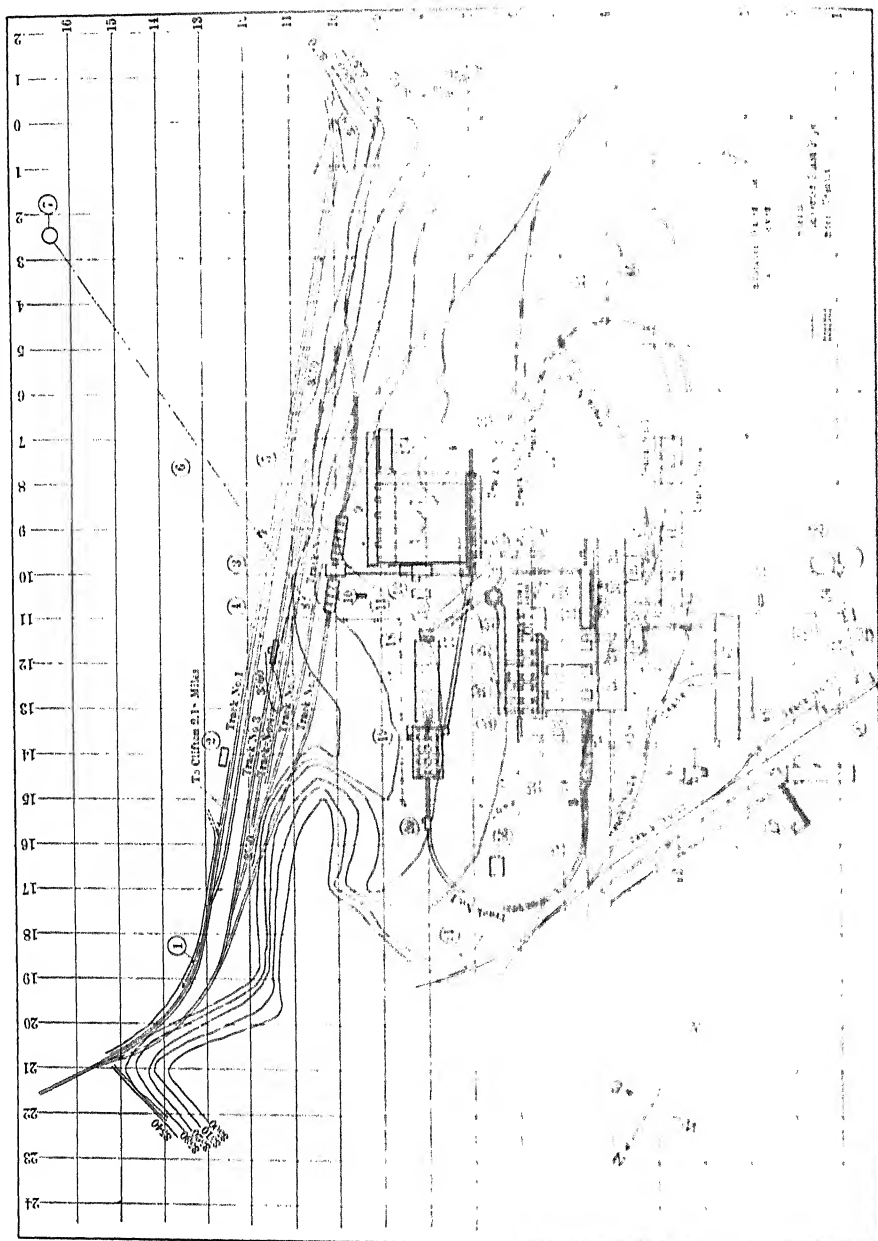
| NAME | Price | Unit |
|--|--------------|--------|
| Asphalt (Trinidad)..... | \$3.62 | Cwt. |
| Asbestos sheets..... | 5.68 | " |
| Brick red standard, 2" × 4" × 8"..... | 16.986 | M. |
| " silica A1 straights, 2½" × 6" × 12"..... | 98.40 | " |
| " B 2 " 2½" × 4½" × 9"..... | 52.20 | " |
| " C 2 " 3" × 6" × 20"..... | 184.19 | " |
| " D 1 " 3" × 6" × 15"..... | 148.62 | " |
| " Fire "Star", 2½" × 4½" × 9"..... | 49.68 | " |
| " "Athens," 2½" × 4½" × 9"..... | 40.00 | " |
| " Magnesite straights, 2½" × 4½" × 9"..... | 171.40 | " |
| " " Special shapes at rate of \$189.40 per M brick 2½" × 4½" × 9", figuring from cubical contents, e.g. "A" special is 2.3796 larger than a 2½" × 4" × 9" brick, therefore would cost 2.3796 × \$189.40. | | |
| Bolts, carriage ½" × 2"..... | 0.97 | C. |
| " machine ½" × 2"..... | 1.01 | " |
| " " ¾" × 2"..... | 2.20 | " |
| " " 1" × 24..... | 13.04 | " |
| Belting conveyor rubber, 7-5 ⅞", 30" wide..... | 3.63 | Lin ft |
| " " 5-3 ⅞", 20" "..... | 1.9468 | " |
| " " 6-4 ⅞", 20" "..... | 2.1898 | " |
| Castings, rough iron..... | 2.00 to 3.00 | Cwt |
| Cement, "El Toro" brand..... | 0.7225 | sack |

Prices of Raw Material F. O. B. Clifton During New Smelter Construction (Con.)

| NAME | PRICE | UNIT |
|--|-------------------|--------------|
| Clay, fire..... | \$7.00 | ton |
| Coal, steam..... | 8.00 to 7.175 | " |
| Conduit $\frac{1}{2}$ " galvanized..... | 6.49 | C. ft. |
| Gasoline..... | 0.23 | gal. |
| Grease "Aretic" No. 4..... | 6.50 | cwt. |
| Glass, factory ribbed, 13 $\frac{1}{2}$ " X 20"..... | 13.28 | C. |
| Hay, alfalfa..... | 20.35 | ton |
| Iron, corrugated No. 22, 10-ft. lengths..... | 0.9729 | sheet |
| " galvanized No. 20..... | 3.49 | cwt. |
| " round and square, base..... | 2.35 | " |
| " flat base..... | 2.35 | " |
| " sheets..... | 2.35 | " |
| Lumber, common R. O. P..... | 26.00 | M. |
| " No. 2 T & G flooring..... | 31.76 | " |
| Lead, white..... | 8.80 | cwt. |
| Lime burnt..... | 10.00 | ton |
| Nails, common, base..... | 2.84 | cwt. |
| Oil, linseed..... | 0.6163 | gal. |
| " coal..... | 0.12 | " |
| Pipe, black 1 in..... | 17.53 | M. ft. |
| " " 2 in..... | 91.84 | " |
| " " 4 in..... | 286.39 | " |
| " " 6 in..... | 516.10 | " |
| " " 8 in..... | 776.87 | " |
| " sewer 6 in..... | 37.94 | C. ft. |
| " " 12 in..... | 52.80 | " |
| " " 24 in..... | 193.00 | " |
| Powder, black..... | 7.1008 | cwt. |
| " "Hercules," 30 per cent. $\frac{1}{2}$ " X 8"..... | 11.576 to 12.0751 | " |
| Rails, 60, second-hand..... | 37.50 | ton |
| Rope, Manila, base..... | 10.50 | cwt. |
| Sand and gravel..... | 1.00 | ave. cu. yd. |
| Shafting 3- $\frac{1}{2}$ " C.R..... | 3.78 | cwt. |
| Silicate of soda..... | 12.182 | hd. |
| Steel structure..... | 3.11 | cwt. |
| Ties, white oak..... | 1.05 | each |
| Tile, 4 X 8 X 12", "El Paso"..... | 58.742 | M. |
| Valves, gate brass "Crane" 1 in..... | 21.06 | C. |
| " " " " 2 in..... | 298.50 | " |
| " " " " 3 in..... | 6.20 | each |
| " " 1B " 3 in..... | 4.98 | " |
| Wire, No. 12 weatherproof..... | 23.18 | cwt. |
| " No. 4 double braid stranded..... | 56.50 | M. ft. |
| " No. 12 galvanized..... | 6.195 | cwt. |



CROSS-SECTION THROUGH REVERBERATORIES AND CONVERTERS.



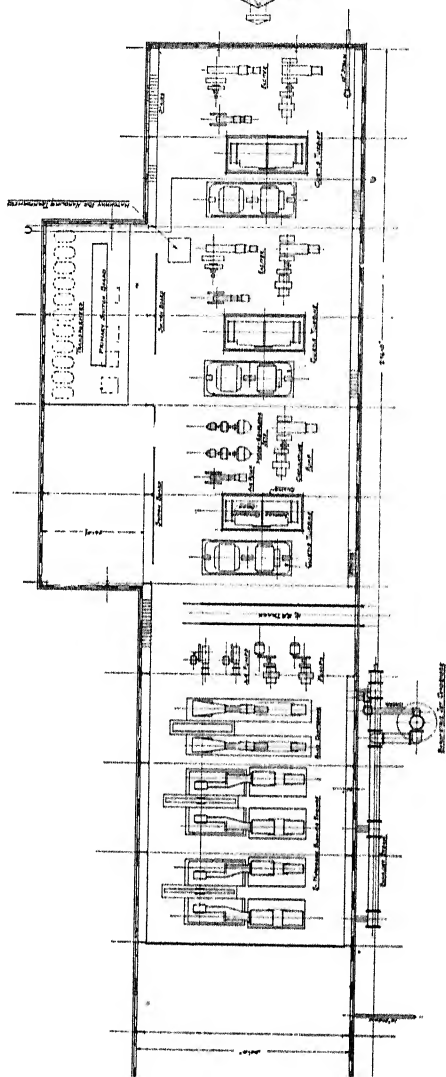
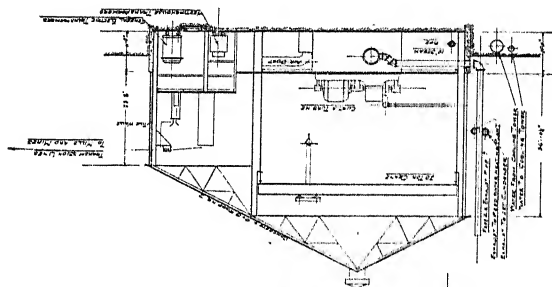
GENERAL PLAN OF SMELTER.
Numbers in circles refer to list on opposite page.

REFERENCE LIST FOR GENERAL PLAN OF SMELTER

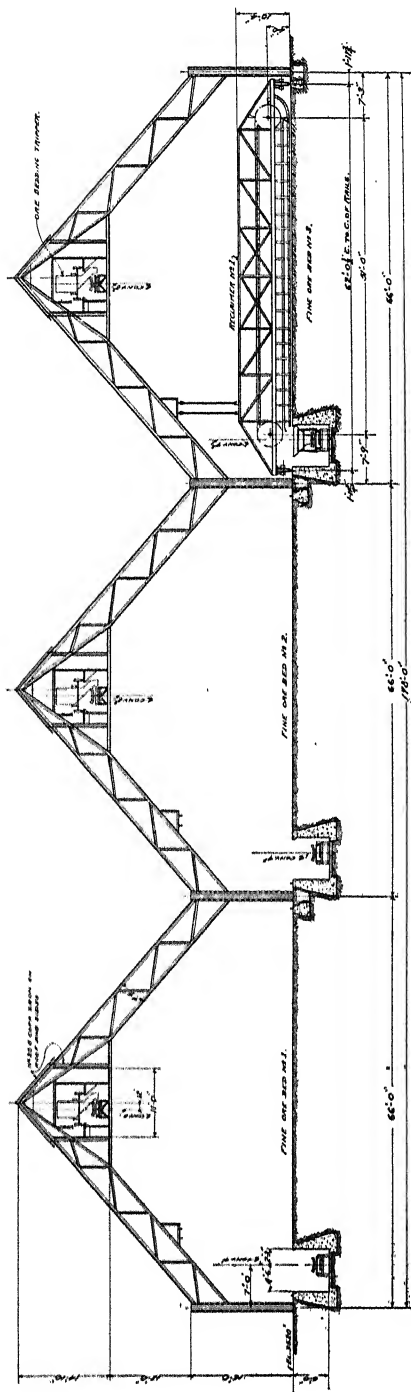
(See Opposite Page)

- | | |
|----------------------------------|--------------------------------|
| 1. Drainage Ditch | 29. Boiler Building |
| 2. Depot | 30. Reverberatories |
| 3. 6-in. Water Main from Clifton | 31. Converter Dust Chamber |
| 4. 150-ton Track Scales | 32. Silica Bins |
| 5. A. N. M. Main Line | 33. Converter Flue |
| 6. 6-in. Water Pipe | 34. Steam Line |
| 7. 250,000-gal. Water Tank | 35. Converter Building |
| 8. Receiving Bins | 36. Converters |
| 9. Transfer Pit | 37. Casting Shed |
| 10. Crushing Plant | 38. Bullion Scales |
| 11. Outside Closet | 39. Casting Shed |
| 12. Sampling Mill | 40. 24-in. Blast Pipe |
| 13. Sample Room | 41. Heater House |
| 14. Three Spreading Beds | 42. Cooling Tower |
| 15. Reclaimer House | 43. Machine Shop |
| 16. Bunker Bins | 44. Boiler Shop |
| 17. Roaster Flue | 45. Warehouse |
| 18. Roaster Dust Chamber | 46. Culvert |
| 19. Roasters | 47. Power House |
| 20. 40-ton Track Scale | 48. Power House Tunnel |
| 21. To Slag Dump | 49. Condensed Water Pump House |
| 22. Calcine Trestle | 50. Oil Sump |
| 23. 8-in. Hot-water Line | 51. 16-in. Oil Pipe |
| 24. Outside Closet | 52. Oil Pump House |
| 25. Feed-water Pump House | 53. 500,000-gal. Oil Tanks |
| 26. Reverberatory Flue | 54. 8-in. Oil Pipe |
| 27. Chimney | 55. 2 1/2-in. Steam Pipe |
| 28. 163-barrel Oil Tanks | 56. Assay Office |

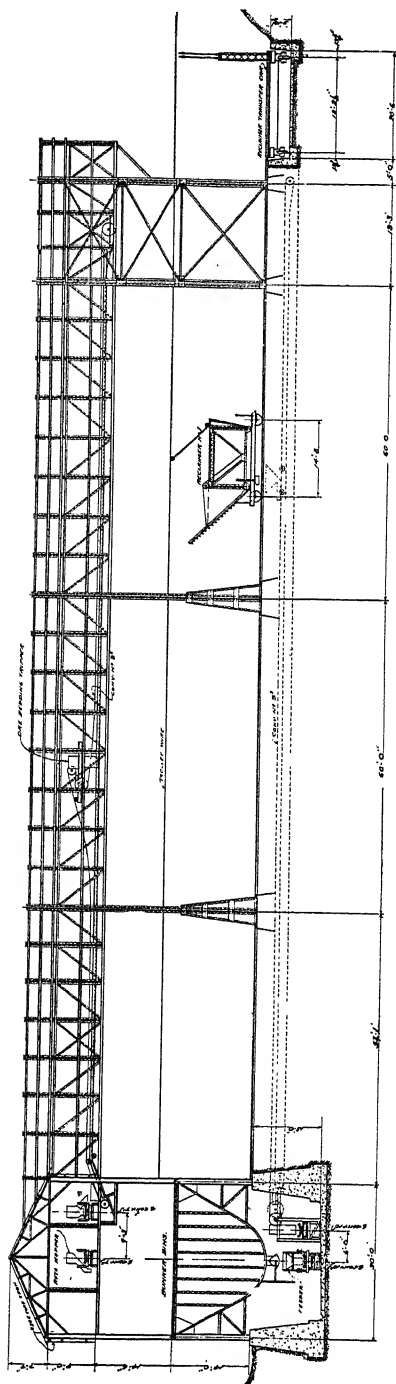
UNIT CONSTRUCTION COSTS



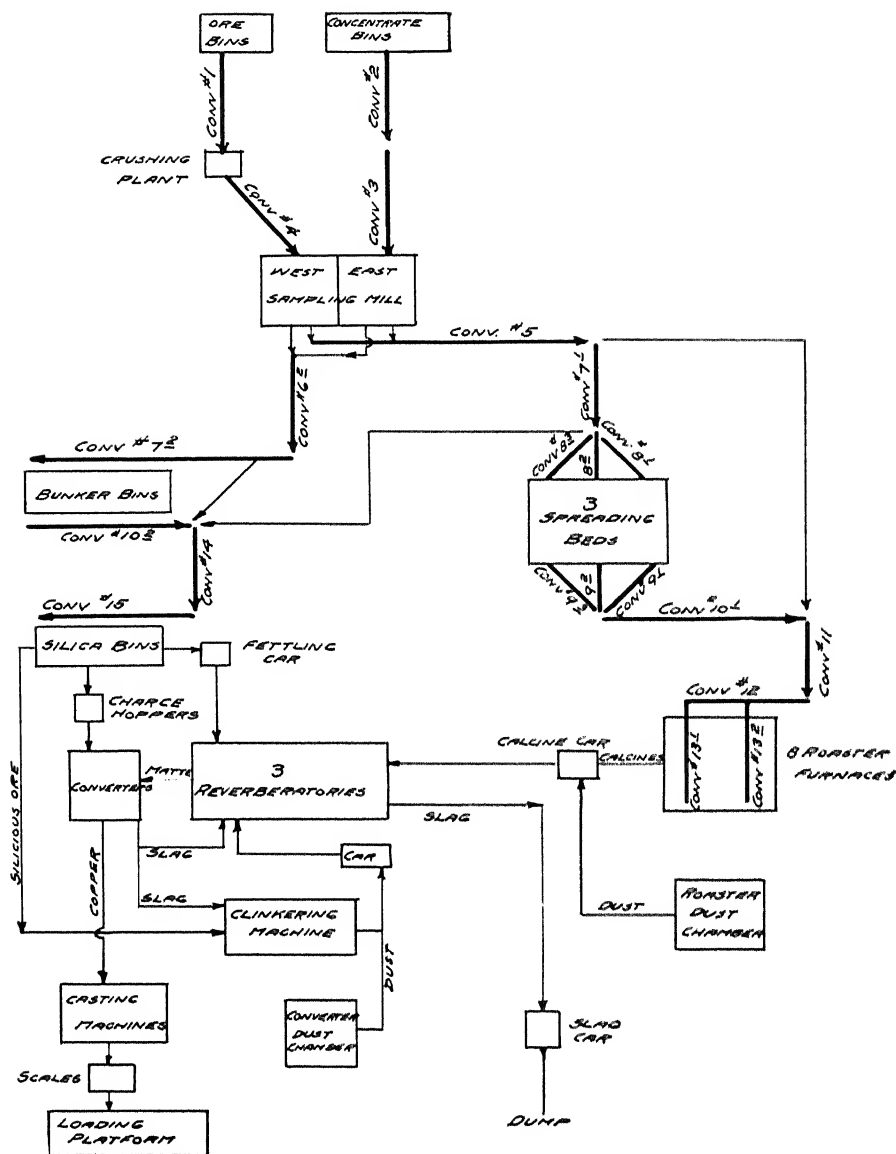
PLAN AND CROSS-SECTION OF POWER HOUSE.



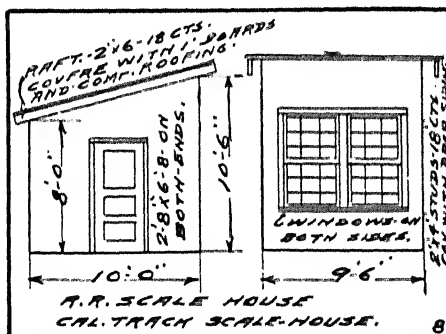
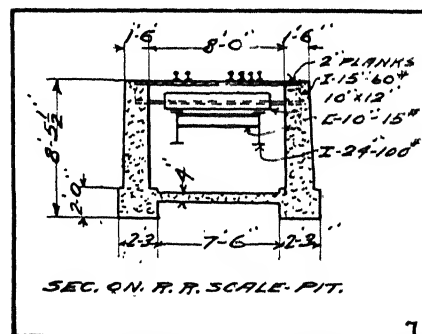
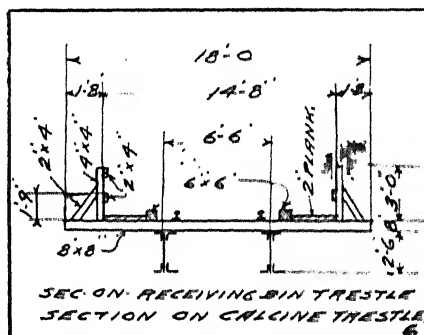
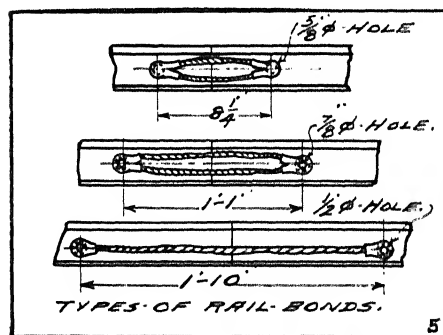
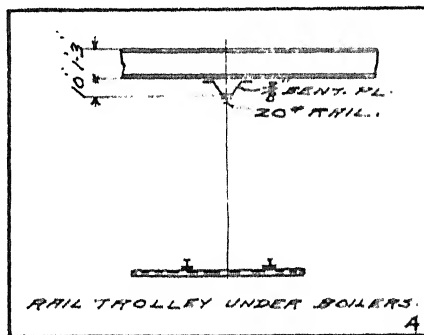
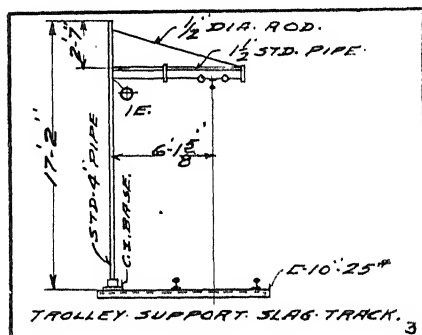
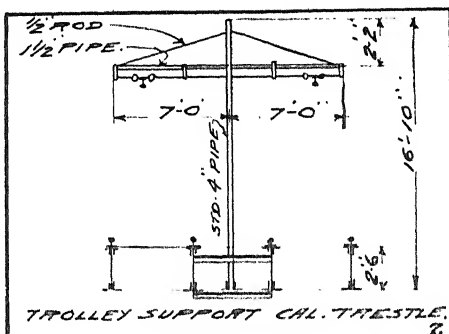
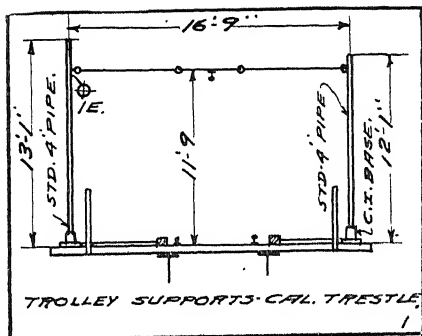
CROSS-SECTION THROUGH BEDDING PLANT, LOOKING EAST.

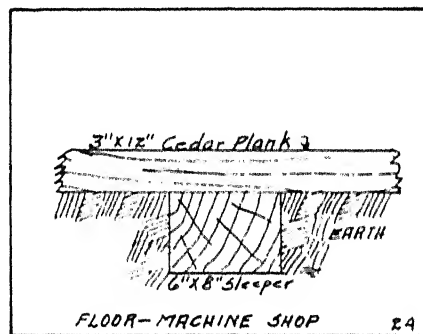
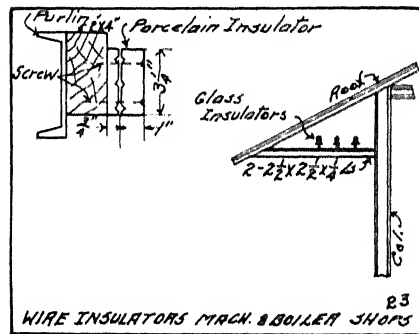
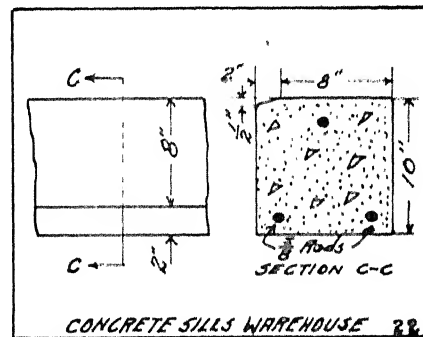
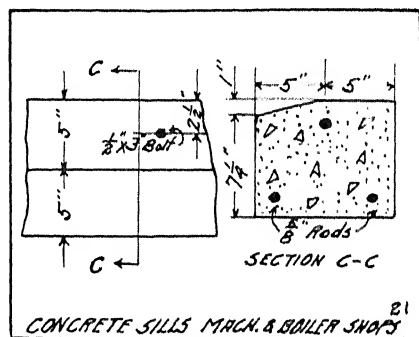
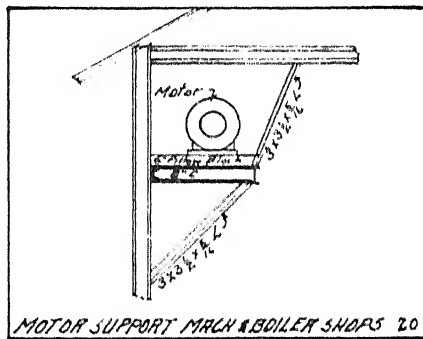
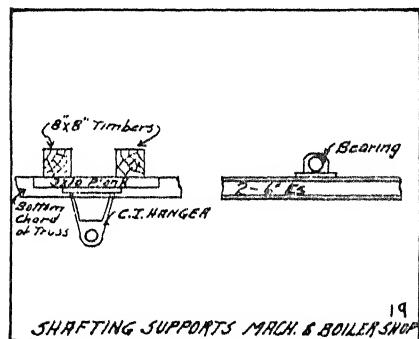
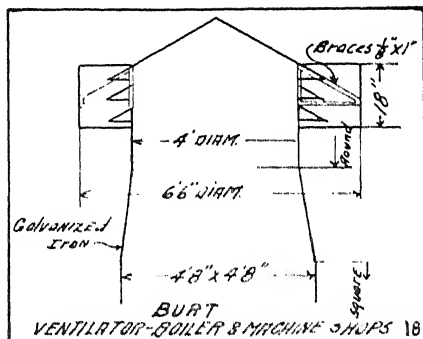
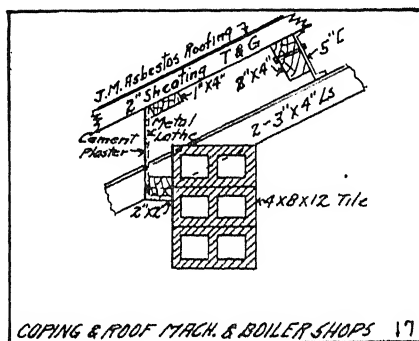


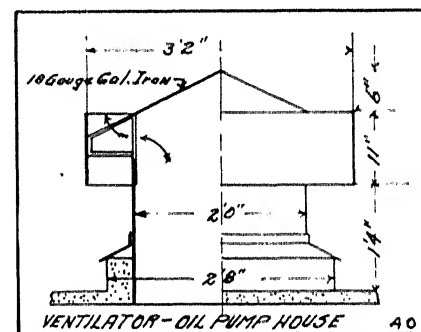
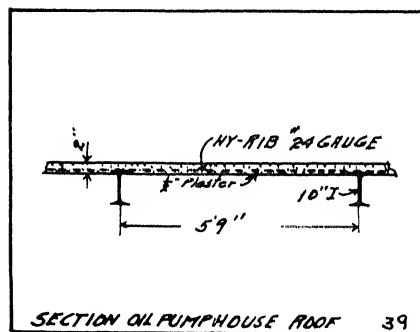
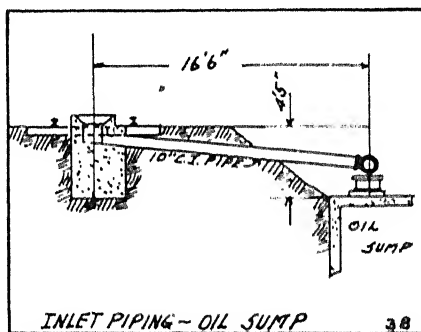
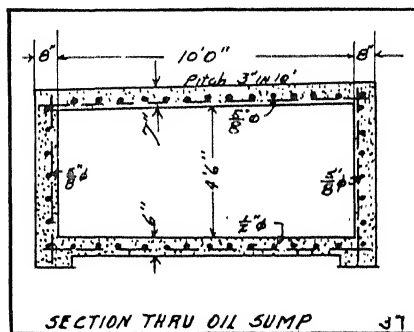
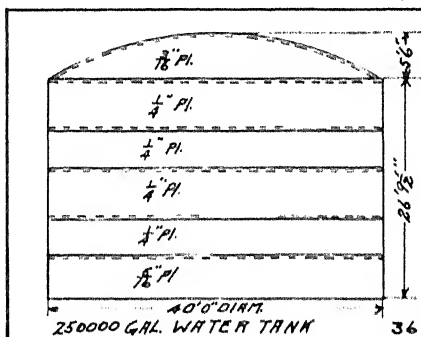
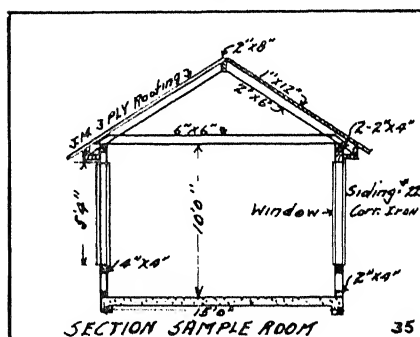
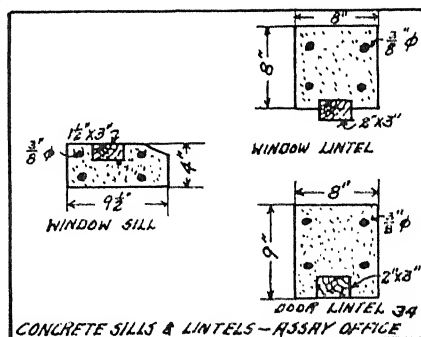
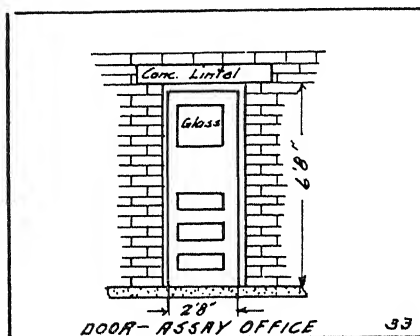
LONGITUDINAL SECTION THROUGH BEDDING PLANT, LOOKING NORTH.

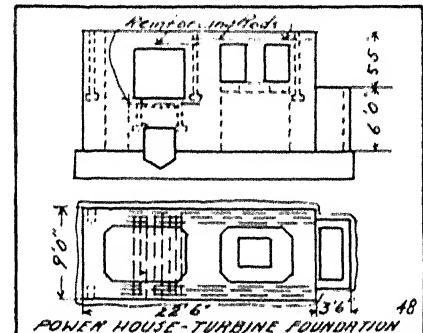
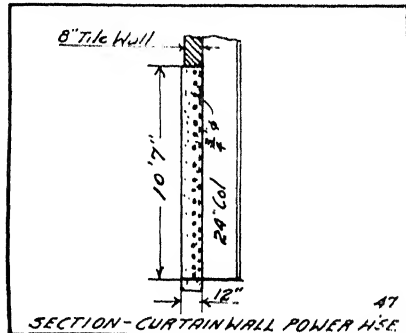
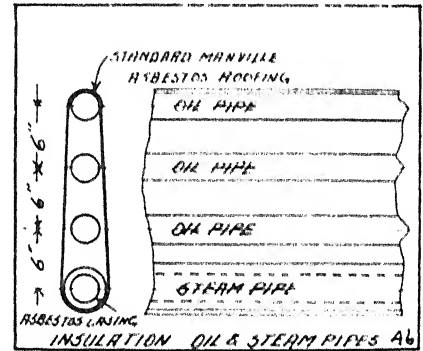
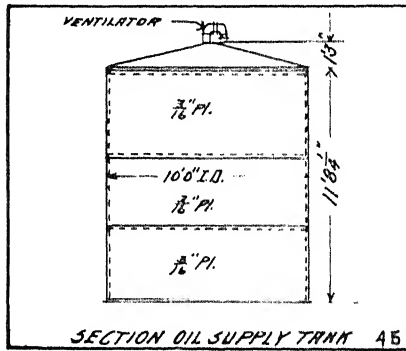
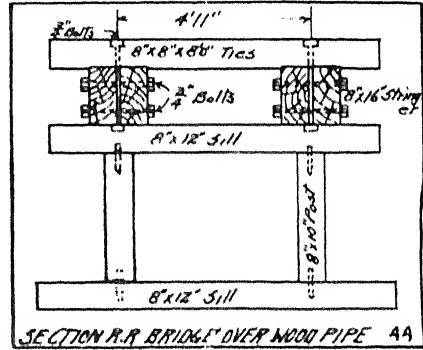
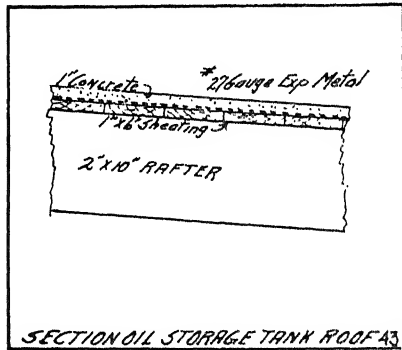
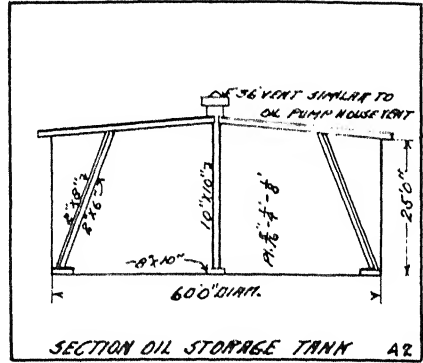
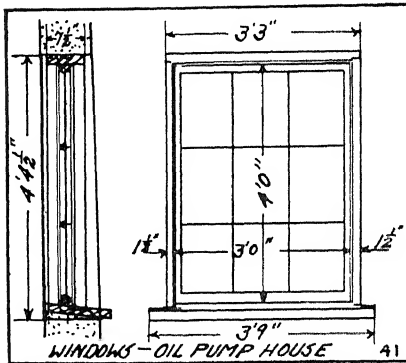


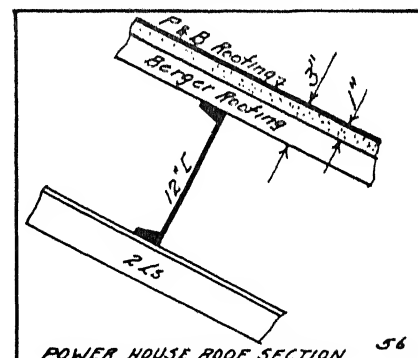
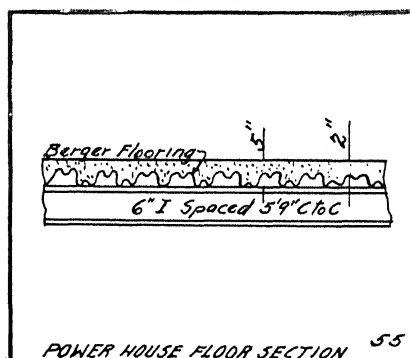
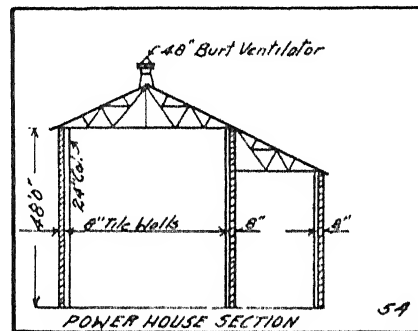
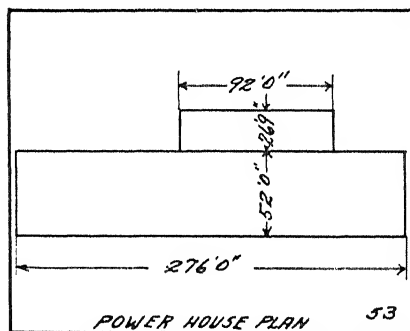
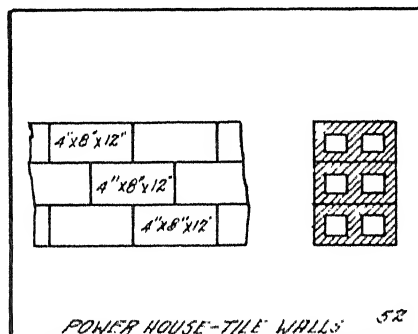
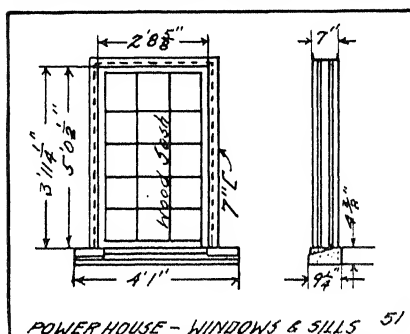
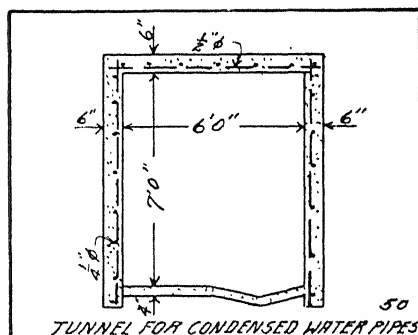
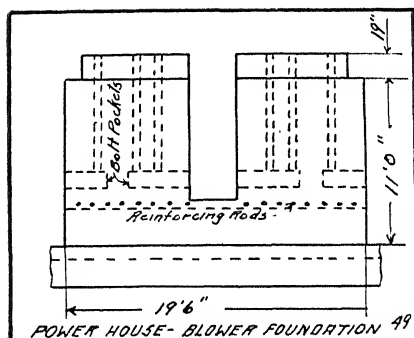
FLOW SHEET OF SMELTER. HEAVY LINES REPRESENT CONVEYORS.

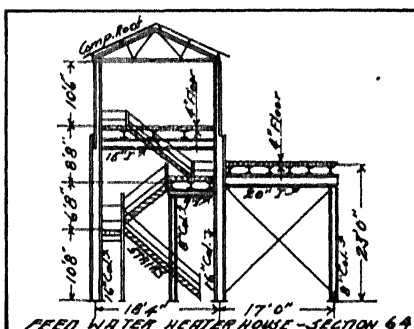
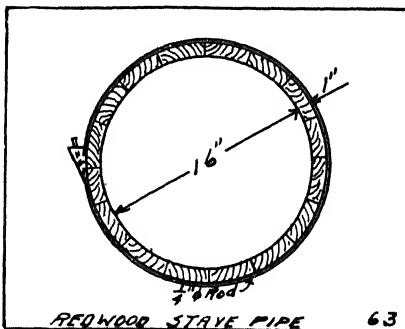
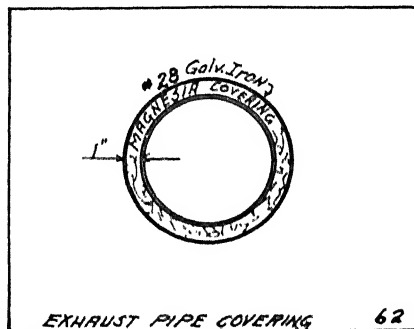
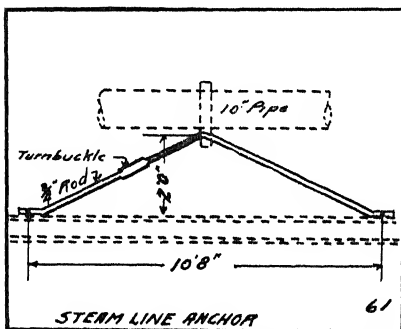
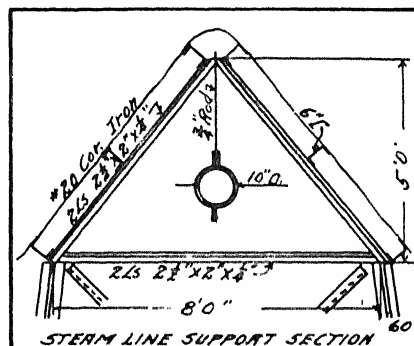
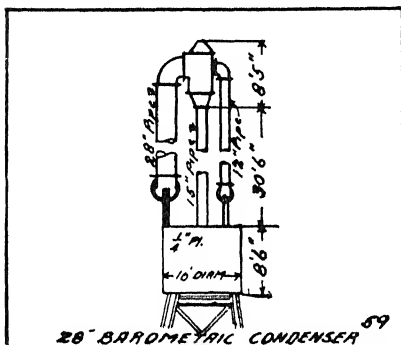
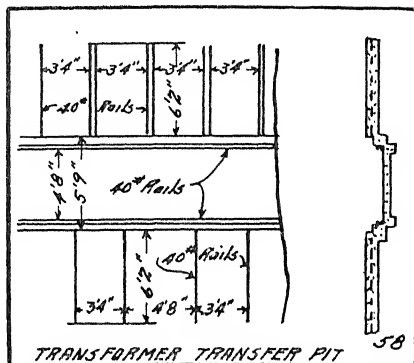
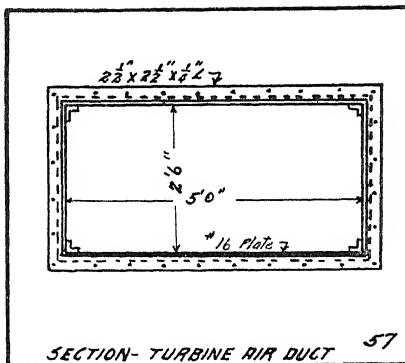


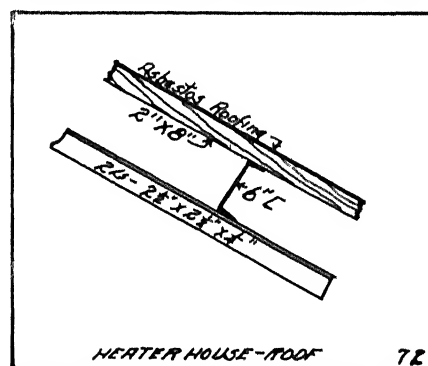
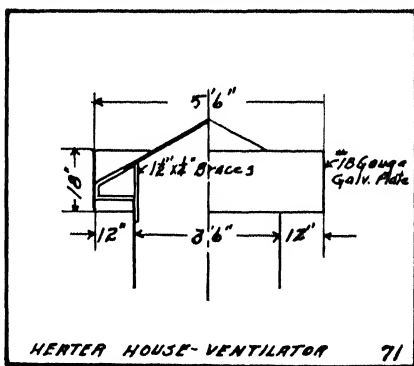
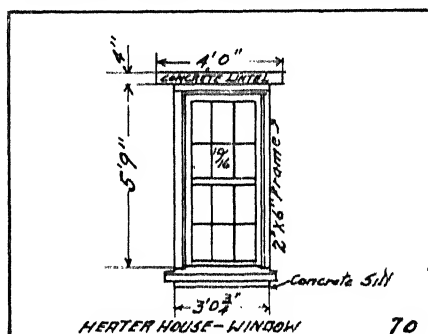
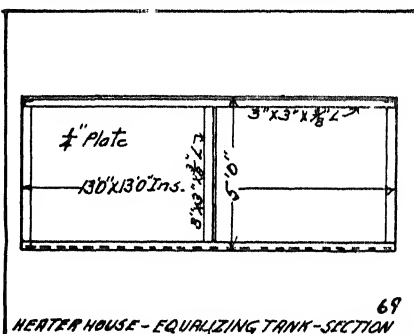
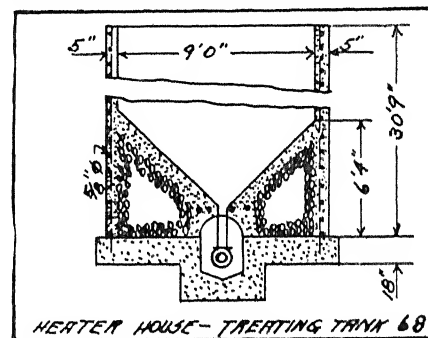
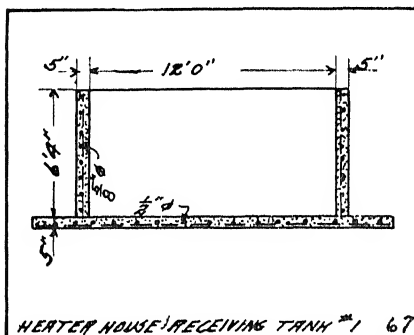
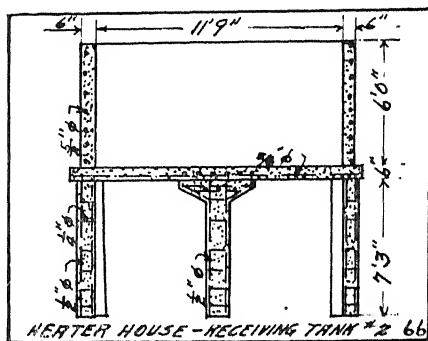
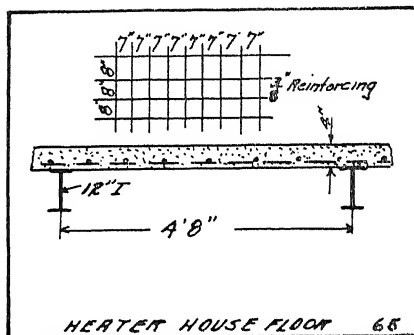


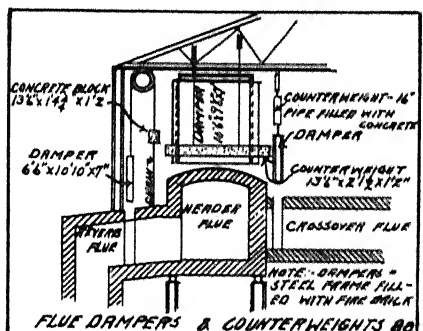
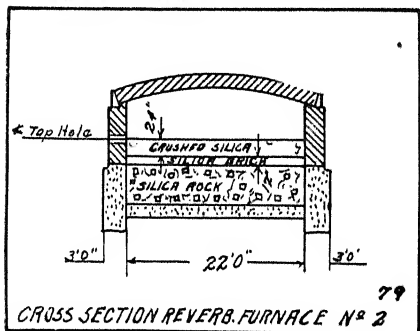
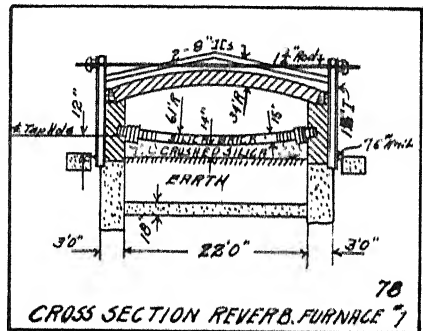
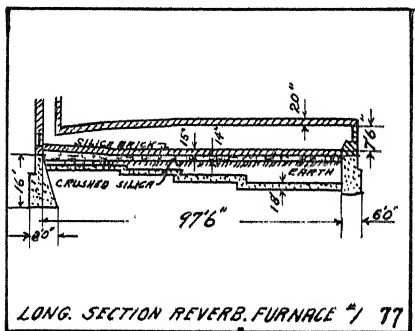
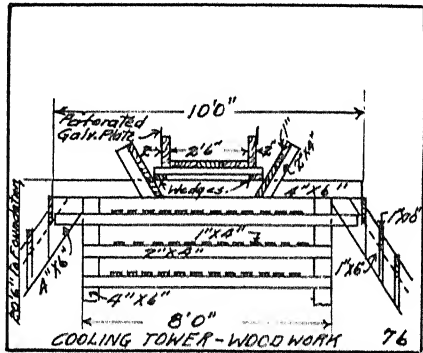
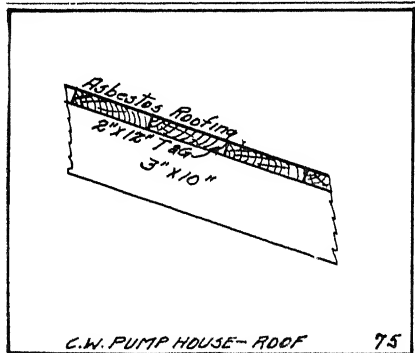
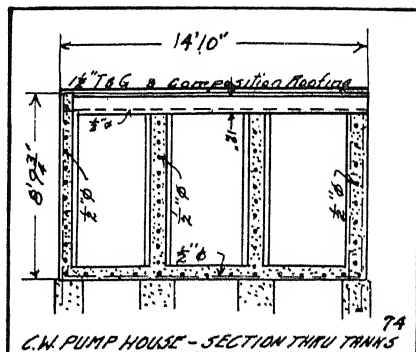
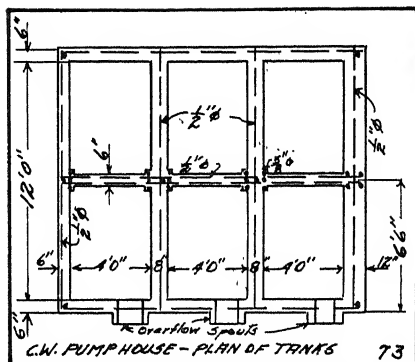


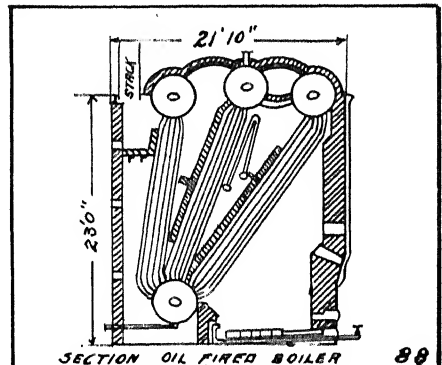
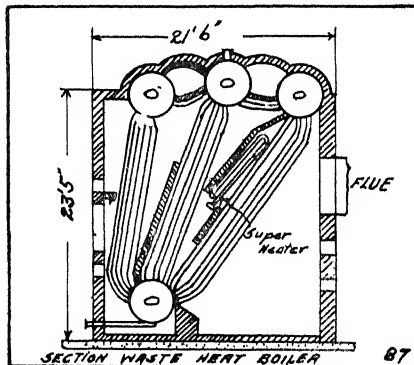
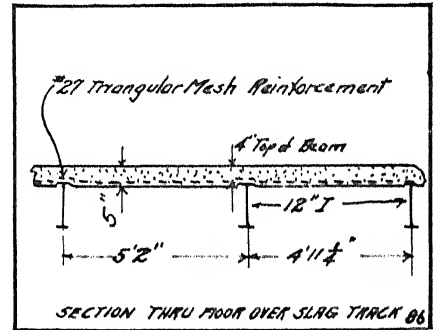
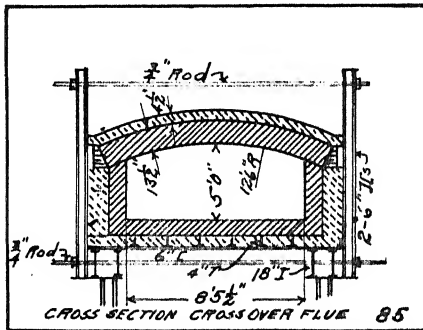
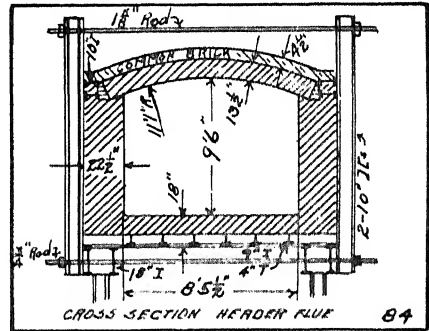
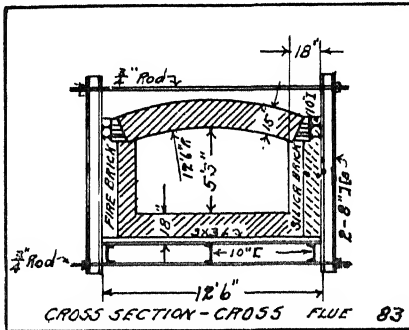
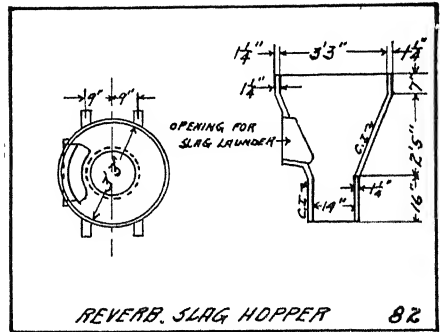
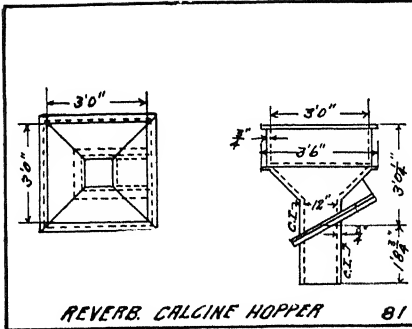


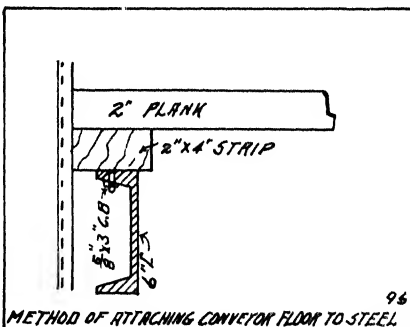
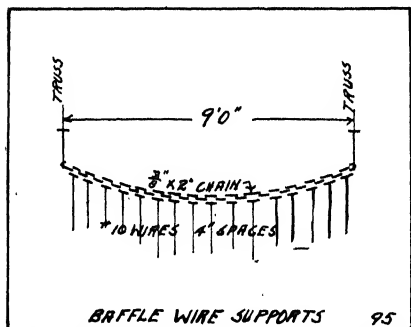
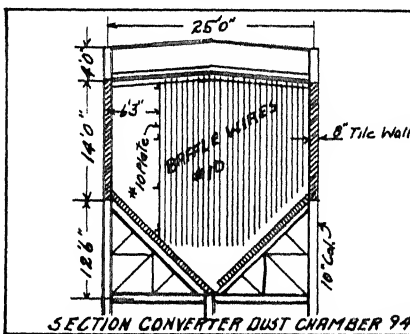
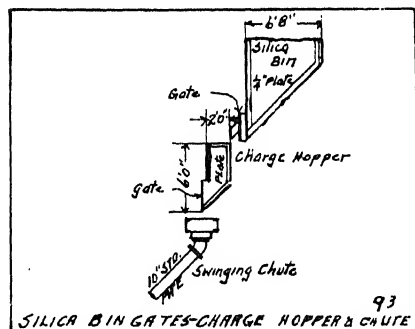
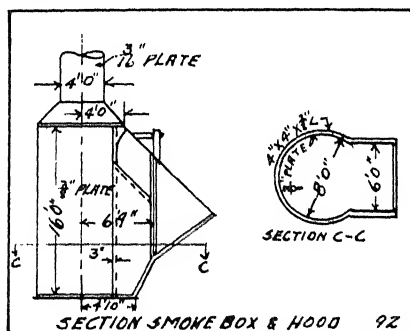
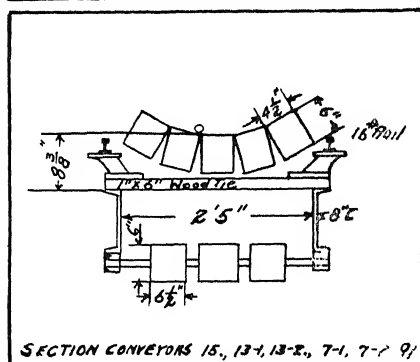
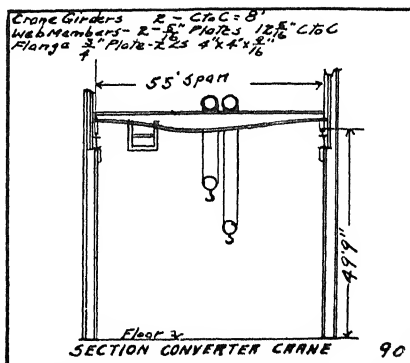
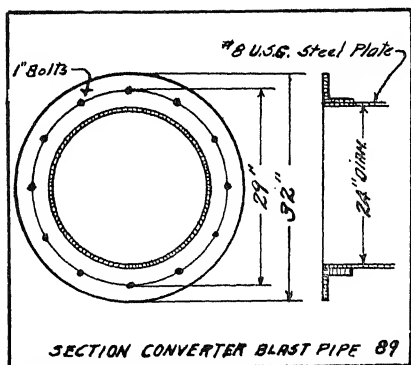


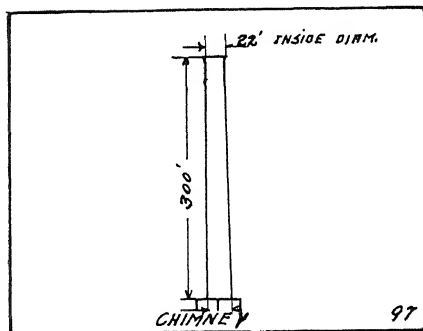




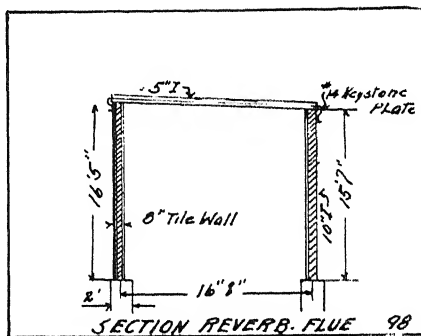




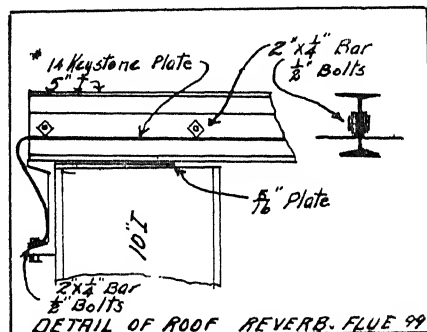




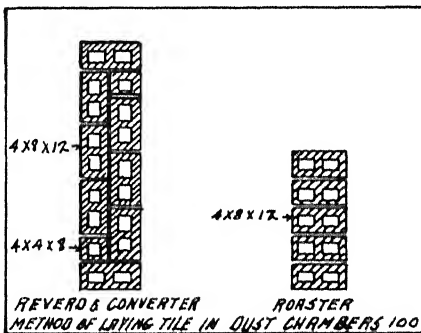
97



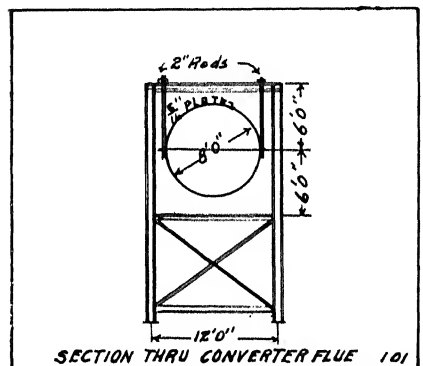
98



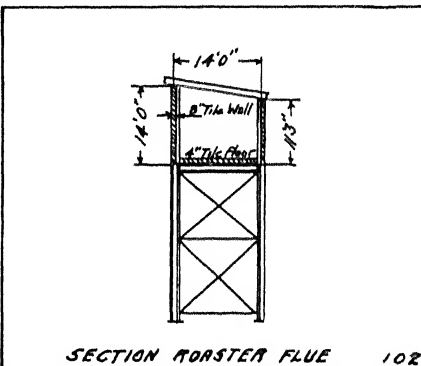
99



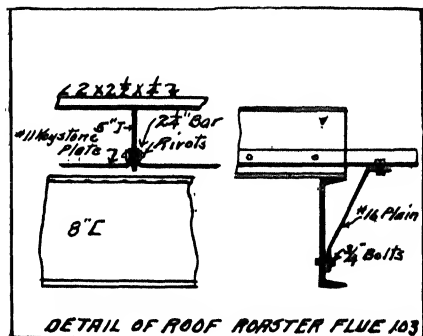
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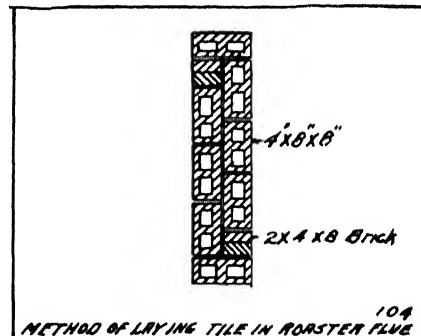
101



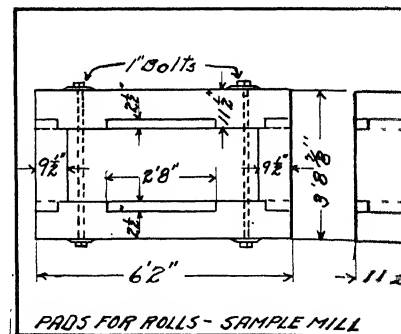
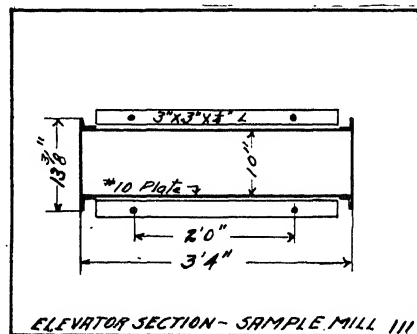
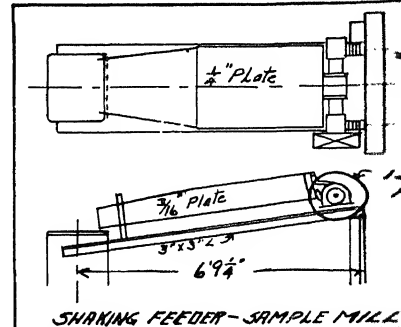
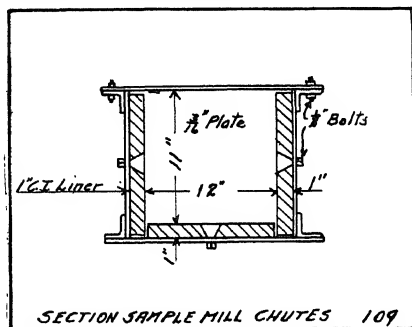
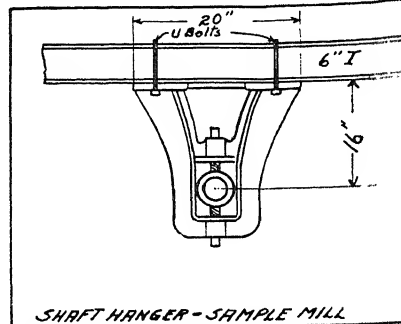
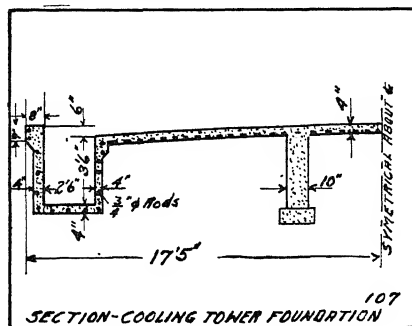
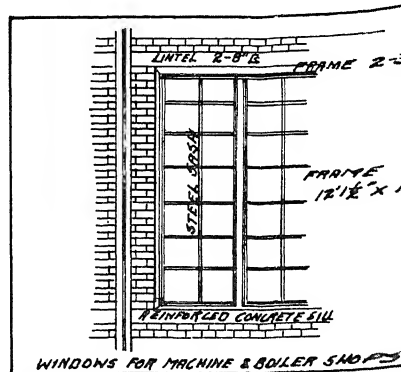
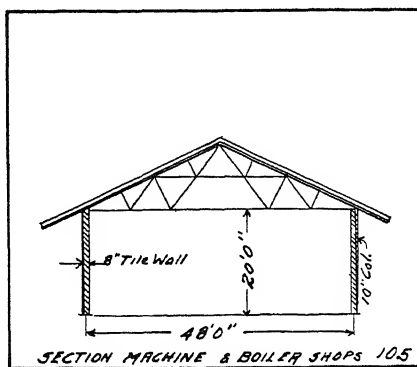
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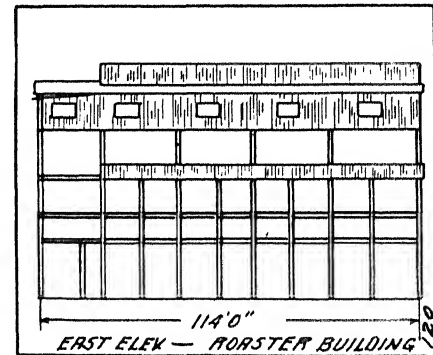
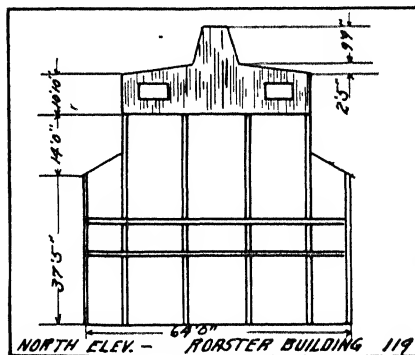
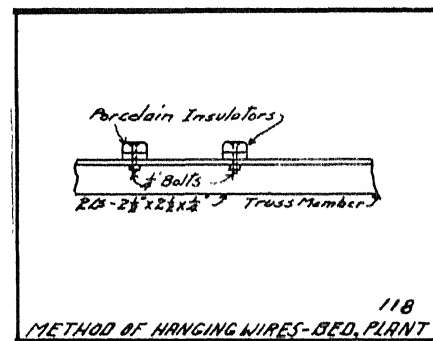
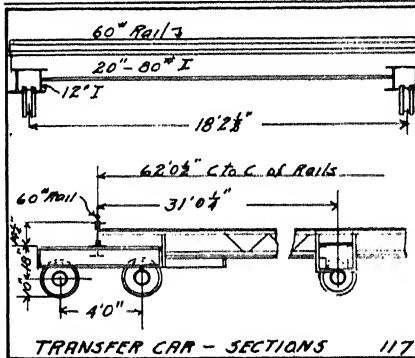
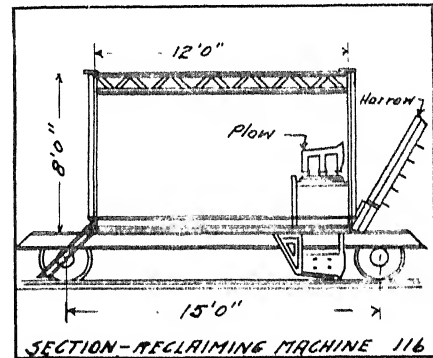
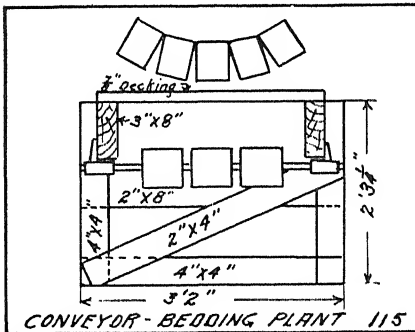
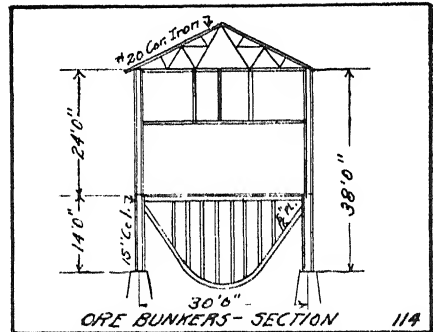
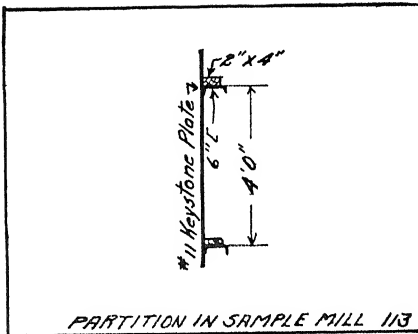


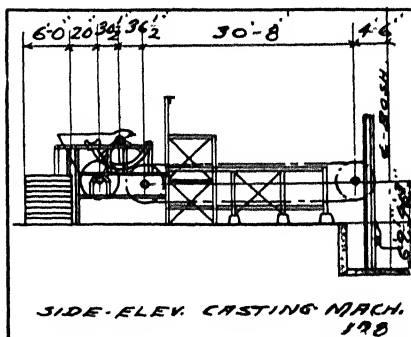
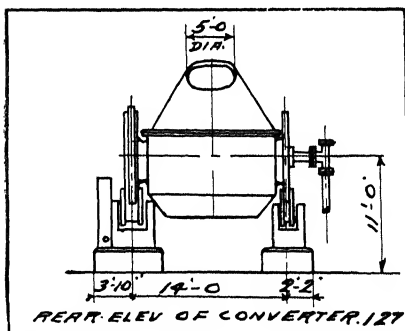
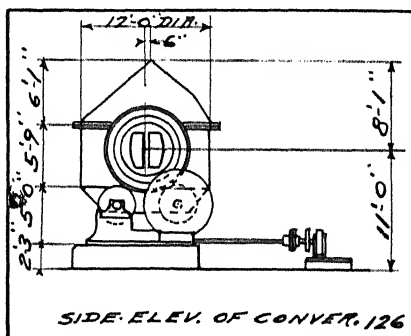
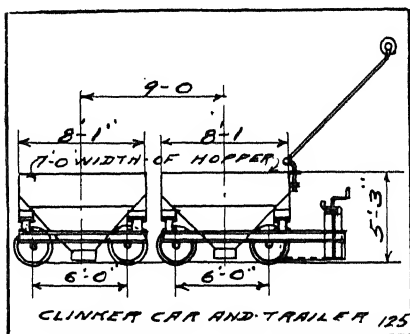
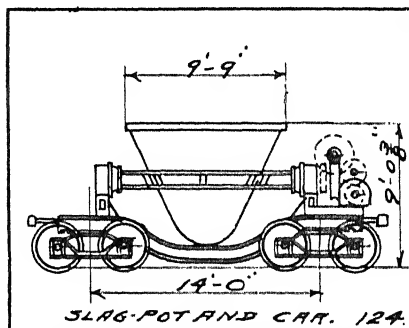
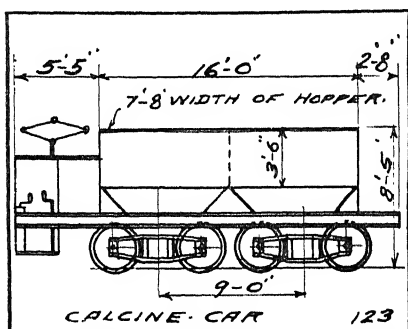
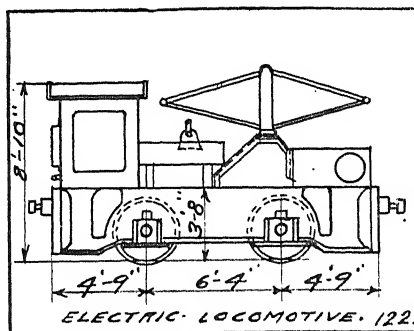
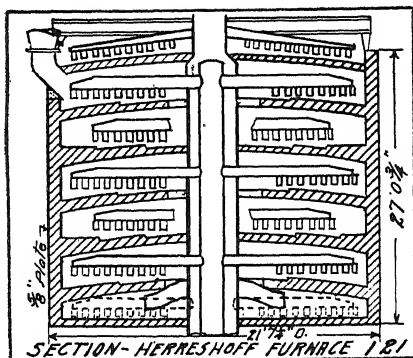
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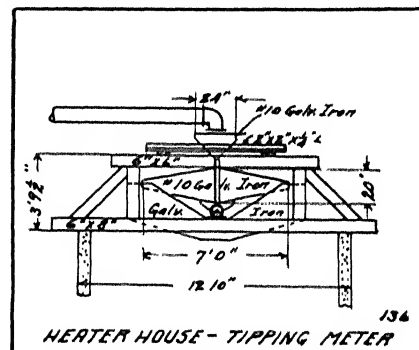
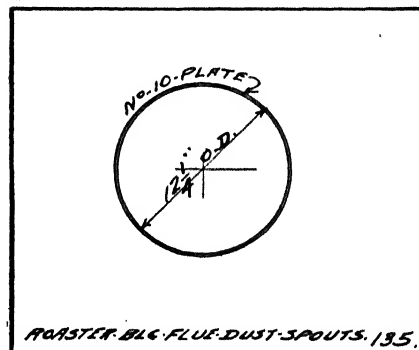
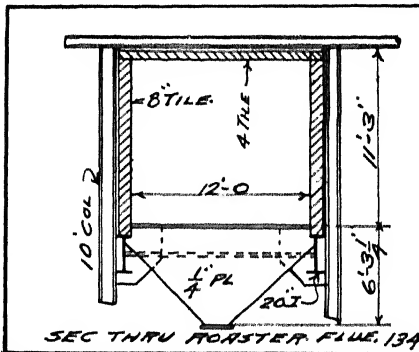
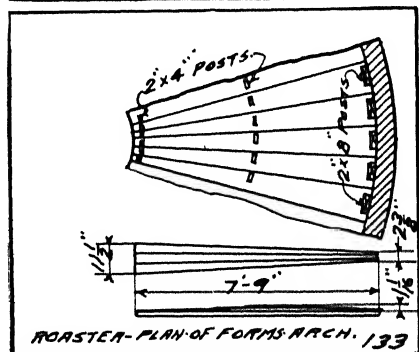
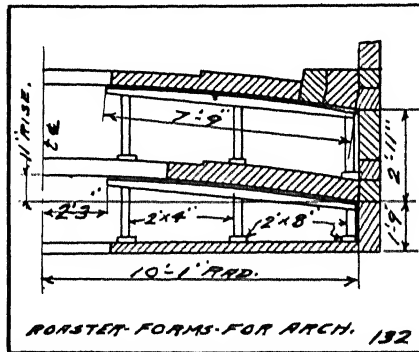
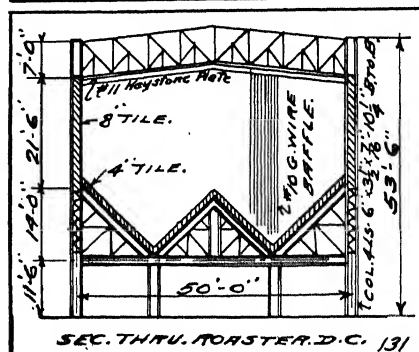
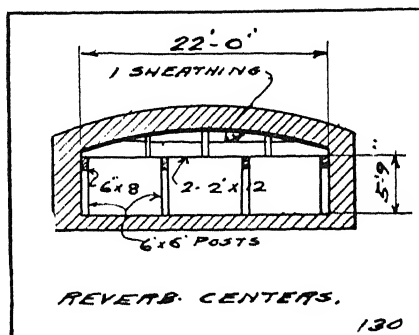
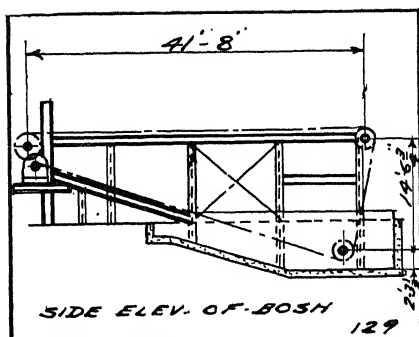


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CHAPTER VI

DESCRIPTION OF COSTS

Engineering

Account 7100—Total Engineering Expense.

This account is a summation of accounts 7,101 to 7,206 inclusive, also of 9,000.1, power plant engineering expense. These accounts cover the engineering expenditures as their respective headings would indicate. As the total engineering expense they represent a percentage of the total cost of the smelter, less the engineering and indirect expenses, and have been so reported. In the making of any total estimate based on the unit costs derived from this sheet, it is assumed that of the total estimate so arrived at, 5.40 per cent. will be taken and added thereto to ascertain the item of engineering.

| | |
|--------------------------------|--------------------------------|
| Account 7001—See Account 8999. | Account 7201—See Account 7100. |
| Account 7004—See Account 8999. | Account 7202—See Account 7100. |
| Account 7101—See Account 7100. | Account 7203—See Account 7100. |
| Account 7103—See Account 7100. | Account 7204—See Account 7100. |
| Account 7104—See Account 7100. | Account 7205—See Account 7100. |
| Account 7105—See Account 7100. | Account 7206—See Account 7100. |

YARD TRACKS AND INDUSTRIAL SYSTEM

Tracks

Account 7301—Excavation.

This cost covers all of the excavating, barrow and grading incident to bringing the road beds of the New Smelter tracks to sub-grade. The materials worked varied from rock (Gila Conglomerate) through hard clayey soil filled with one-man stones, to light loam. The means employed to excavate covered the use of powder, plows, picks and shovels, slips and fresnos. The work covered by this cost was not carried on continuously, but as conditions about the plant permitted. The unit cost represents fairly the average cost of shallow excavating in large amounts about the smelter site.

Account 7302—Ties.

This account represents 700 steel ties, 7,656 white-oak ties laid in track, 524 white-oak ties in stock, 300 Oregon pine switch ties laid in track, and 1,082 white-oak ties used in temporary tracks and in handling machinery. There is also included here the labor of unloading, stocking, handling to points about the plant and placing upon the various grades. The steel ties are 7 ft. long, furnished with four No. 23 clips for 60-lb. A. S. C. E. rail, laid on 4 ft. 8½ in. gauge. They

were furnished by the Carnegie Steel Company and cost \$1.66 each. (See Fig. 10.) The white-oak ties are rough hewn, 6 in. by 8 in. by 8 ft. and cost \$1.05 apiece.

The switch ties were of Oregon pine, standard size and various lengths, according to their position in the track and the size of frog. They cost at the rate of \$30.00 a thousand, board measure. The account thus stands as follows:

| | | |
|-----------------|----------|-------------|
| Labor..... | \$425.13 | |
| Wood ties..... | 9,614.86 | |
| Steel ties..... | 1,162.93 | |
| | <hr/> | \$11,202.92 |

The average cost of each wood tie in the track represents \$1.31. The ties were laid about 58 to the 100 ft. (See Fig. 10.)

Account 7303—Rails and Rail Fastenings.

The rails covered by this account were second hand, purchased from the Arizona and New Mexico Railway; 60 lb. A. S. C. E. standard. The track laid totaled 14,813 ft. long and was divided as follows:

| On wood ties in dirt | | On trestle | |
|----------------------|-----------|-------------------|---------|
| Track No. 6..... | 2,660 ft. | Track No. 7..... | 294 ft. |
| 7..... | 1,023 ft. | 15..... | 403 ft. |
| 8..... | 1,940 ft. | | |
| 9..... | 340 ft. | | |
| 10..... | 645 ft. | On steel ties | |
| 12..... | 1,053 ft. | Track No. 13..... | 665 ft. |
| 13..... | 1,396 ft. | | |
| 14..... | 1,060 ft. | | |
| 15..... | 1,685 ft. | | |
| On wood ties in dirt | | On steel ties | |
| Track No. 17..... | 212 ft. | Track No. 14..... | 283 ft. |
| 18..... | 279 ft. | | |
| 19..... | 290 ft. | | |
| 24..... | 585 ft. | | |

The account is divided up as follows:

| | |
|---|------------|
| 29,626 ft., 60 lb. rail @ \$27.50 a ton.. | \$8,147.15 |
| 986 pr. angle bars @ \$0.50..... | 493.00 |
| 4,000 bolts @ \$3.50 a hundred | 140.00 |
| 4,000 nut locks \$1.07 a hundred | 42.00 |
| 95 kegs spikes @ \$4.54..... | 431.30 |
| | <hr/> |
| Miscellaneous..... | \$9,254.25 |
| | <hr/> |
| | \$9,839.79 |
| Labor..... | 392.00 |

The miscellaneous item covers many second hand tie plates, short rail, material for extra angle bars made on the site, and a portion of temporary construction. The labor item represents handling, unloading and work on angle bars incident to different punching of rails.

Account 7304—Frogs and Switches

This item covers the cost laid in track of the following number of frogs purchased from the Cincinnati Frog and Switch Company:

- 9 No. 9 frogs with switches
- 7 No. 4 frogs with switches
- 2 No. 2½ frogs with switches.

It also covers labor incident to replacing 4 or 5 old frogs laid previous to the arrival of the new material. Included with the old installation labor is the cost of making several new switch points.

Account 7305—Laying, Surfacing and Ballasting.

This account covers the laying of all tracks in the industrial system about the smelter and the ballasting of such tracks where ballasting was required. The total amount of track laid was 17,130 ft., of which 697 ft. was upon steel trestles.

The ballast used varied according to the conditions prevailing at the time. A large amount of the track was ballasted with material borrowed near the site, while other portions were ballasted with red oxide tailings from the leacher at the cost of \$0.25 a yard, either dumped upon the track and spread with the use of the locomotive, or because of the excessive degree of track curvature for the locomotive, dumped and hauled to the place required.

The work of track laying and ballasting extended over many months, being prosecuted as the tracks were required for use, and in some cases as the steel arrived or ballast could be obtained. All tracks were standard gauge.

Trolley System

Account 7306—Poles and Setting.

This account covers the cost of stands, poles and ties to which the poles were attached as well as the labor incident to the erection of this work. There were 102 poles made of 4-in. pipe on an average of 16 ft. long set in a cast-iron stand 16 in. high. The accompanying sketches show four different conditions; double track with two poles used on the far sides of both tracks; double track one pole used between two tracks; single track and one pole and bracket on the under side of the slag track cut floor. (See Figs. 1, 2, 3 and 4.)

Account 7306.1—Brackets and Wiring.

This account covers all the material and labor incident to putting up the trolley line brackets, stringing the wire and insulating the work. The length of the trolley system is 7824 ft. of which 7,346 ft. is No. 000 H. D. grooved copper wire and 478 ft. of 25 lb. rail used through the slag track cut. The cost here has been figured on the lineal feet of system. Below is a list of the majority of items in the material account.

- 50 Insulator brackets similar to Ohio Brass Co. No. 1,254
- 200 Trolley brackets similar to Ohio Brass Co. No. 10,998
- Six 15° frogs similar to Ohio Brass Co. No. 10,115
- Six 15° frogs similar to Ohio Brass Co. No. 10,016
- Three 15° frogs similar to Ohio Brass Co. No. 10,388

The messenger wire was $\frac{1}{4}$ -in. strand extra soft galvanized steel strand. Extension arms were made of $1\frac{1}{2}$ -in. pipe, 9 ft. long. One-quarter inch rod was used for arm brace. The voltage carried for the line is 230 D. C.

Account 7306.2—Rail Bonds.

This account covers cost of all material and labor incident to making the electrical bond throughout the trolley system. Each bond required the drilling of two $\frac{7}{8}$ -in. holes through the web of the rails. For the most part it was necessary to remove and replace the angle bars. Five hundred twenty-one No. 000 cable rail bonds with $\frac{7}{8}$ -in. hollow comp. studs, 1 ft. 11 in. center to center—see Fig. 5—type C. P. 2—A. S. & W. Co. furnished complete with drift pins. (See Fig. 5.)

Account 7306.30—Lighting.

This account covers the cost of all material and labor incident to lighting the trolley line. The electricity here used was taken direct from the trolley lines. Fifty-seven lamps—240 volt—120 watt carbon filament were installed. Four thousand feet of wire were used.

Rolling Stock**Account 7307—Cars, Electric Locomotives, etc.**

This account covers the cost of the following equipment together with the labor of unloading, trying out, removing the air brakes from the slag cars which came in on their own wheels, installing extra controllers on slag cars, and a large amount of repair work not carried by account 7307.1.

| | Factory Cost | Freight | Total |
|---|-----------------|------------|-------------------|
| Three 18-ton calcine cars, weight of each including electrical equipment 33,200 lb. from Kilbourne & Jacobs Mfg. Co. | \$7,200.00 | \$1,394.22 | \$8,594.22 |
| Four 225-cu. ft. capacity electrically operated slag cars, from M. H. Treadwell Co. Cars are side dumped by 15-h.p. motors; can also be dumped by hand. Weight of one car 57,000 lb. | 11,620.00 | 513.48 | 12,133.48 |
| Two 18-ton electric locomotives from Westinghouse Mfg. Co. Draw-bar pull 8,000 lb. Each locomotive has two 84-h.p. motors. Weight of each locomotive is 43,950 lb. | 8,500.00 | 1,380.03 | 9,880.03 |
| Weight of each locomotive is 43,950 lb. | 8,500.00 | 1,380.03 | 9,880.03 |
| One clinker larry car, 12½ tons capacity, 10-h.p. motor, weight 11,000 lb. | 1,450.00 | 176.00 | 1,626.00 |
| Two trailer cars, 165 cu. ft. or 25,000 lb. capacity, weight of each car, 5,000 lb. | 680.00 | 160.00 | 840.00 |
| Two 15-h.p. 220-volt drum type controllers for electric locomotives to dump slag cars | ..... | ..... | 165.64 |
| One pair Schoen rolled steel wheels with axles for slag cars above. .... | ..... | ..... | 115.66 |
| Miscellaneous material. .... | ..... | ..... | 662.60 |
| | | | <hr/> \$34,017.63 |

(See Figs. 122, 123, 124, and 125.)

Account 7307.1—Calcine Car Alteration.

The calcine cars with their pantographs on top were too high to operate successfully beneath the roasters. To overcome this difficulty the tracks beneath were lowered 1 ft. and the cab end of the car was cut down 18 in. in height. The pantograph was then placed on the cab end of the car. Much difficulty was also experienced with the pantographs themselves, especially when the cars were on short curves and taking switches. This account covers all the labor and material incident to overcoming these difficulties.

Trestle Approach to Reverberatory Building

Account 7308—Excavation.

The ground excavated was cemented sand and gravel, overlain with soil permeated with caliche. All the work was done by hand, using picks and shovels. The excavated material was cast to the side of the pier holes, and in some cases it was handled three times.

Account 7308.1—Foundation.

The kind of foundation here represented is the pier type. Sixty piers were cast 5 ft. by 5 ft. by 8 ft. One large abutment was 26 ft. high,

including its footing. The mixture of concrete used was 7 parts of gravel and sand to 1 part of cement, mixed by hand and transported in wheelbarrows, an average of 80 ft. There was no reinforcing, but two anchor bolts, $\frac{7}{8}$ in. by 2 ft. long, were placed in every footing. About 70 per cent. of the concrete was formed. The pier tops were finished to a perfect elevation. This is true of all other foundations where they support steel columns.

Account 7308.2—Steel Structure.

This steel trestle was a part of a contract between the Arizona Copper Co. and the Kansas City Structural Steel Co. who furnished erected the major portion of the structural steel about the plant, at a ton price of \$72.80 f.o.b. El Paso, and the corrugated iron at \$81 f.o.b. Pittsburgh. In every case where a steel structure occurs in this cost sheet, an additional amount of money has been expended for a variety of purposes. A new unit price is therefore obtained which varies with the structure in question. The extra expenses entailed are the freight from Pittsburgh and El Paso, the lumber for nailing strips, air lines and power for riveting and erecting, extra trackage to deliver steel within required distance of erection site according to contract, and many smaller items rightly debited here. The unit figure therefore arrived at gives the actual cost of the steel structure as it stands in every case. There were 163.97 tons of structural steel used here.

Account 7308.3—Woodwork.

This account covers the labor and material for the ties, walkways and railing upon the steel trestle. In the case of the ties they were laid for large part upon 173-ft. radius curve and required dapping to accommodate a $\frac{1}{2}$ -in. web projection of steel plate sticking up from each of the two girders which they spanned. The material used was as follows:

| | |
|---|----------|
| 18,398 ft. b.m. 8 in. by 8 in. ties o.p..... | \$652.98 |
| 9,248 ft. b.m. 2 in. by 4 in.; 4 in. by 4 in.; and 2 in. by 12 in. 872 lb. $\frac{3}{4}$ -in. round iron..... | 21.37 |
| Nails, bolts and miscellaneous..... | 94.57 |
| | <hr/> |
| | \$768.92 |

150 Ton Track Scales—Receiving Yard

Account 7309—Excavation.

The excavation was in tight sand and gravel. It was done with pick and shovel, handled into cars and hauled 500 ft.

Account 7309.1—Foundation.

This was a job of plain concrete mixed 8 parts sand and gravel to 1 part cement, hauled 2,000 ft. by teams and wheeled in barrows 50 ft.

to place. The concrete was principally walls with a few piers. Eighty per cent. of the exposed surface, other than top and bottom, was formed. A great many $\frac{3}{4}$ -in. bolts were set in the concrete. (See Fig. 7.)

Account 7309.11—Cost and Erection.

This account covers the material and erection of one 50-ft., 150-ton suspension platform track scale with type-registering beam, graduated by 10 lb. The platform was arranged for two gauges of dead and live rails—4 ft. 8 $\frac{1}{2}$ in. and 3 ft. The scale was furnished by Fairbanks and Morse. The material portion of this account is divided up as follows: (See Fig. 7.)

| | Cost | Freight | Total |
|--|------------|----------|------------------|
| One 50-ft. 150-ton suspension platform track scale..... | \$1,351.00 | \$486.09 | \$1,837.09 |
| 294 rail clips..... | 45.00 | 77.36 | 362.91 |
| 75 stands and 72 rail blocks..... | 211.85 | | |
| Patterns for blocks and stands..... | 28.70 | | |
| Structural steel for track scales..... | | | 1,089.62 |
| Twenty-five 10 by 12 6 ft. ties and 2 by 12 planks covering..... | | | 55.83 |
| Bolts, washers, round iron, nails, etc..... | | | 105.41 |
| | | | <hr/> \$3,450.86 |

Account 7309.30—Scale House.

This account covers the cost of material and erection of the scale house. The building in plan is 9 ft. 6 in. by 10 ft. with a shed roof. In front it is 10 ft. 6 in. high, and in the rear 8 ft. The studding is 2 in. by 4 in. and the rafters are 2 in. by 6 in. The siding is corrugated iron and on the roof is 1-in. sheathing and composition roofing paper. There are two windows in both front and rear, and a door in each end. (See Fig. 8.)

Bridge No. 1

Account 7310.1—Foundation.

The concrete covered by this account consisted of two footings about 6 ft. by 6 ft. by 55 ft. with two abutments about 3 ft. by 14 ft. by 55 ft. at base to 14 ft. at top. It was plain concrete, 7 parts sand and gravel and 1 part cement, mixed by hand and by machine and wheeled 45 ft. to place. Ninety per cent. of the vertical and inclined surfaces were formed.

Account 7310.10—Bridge No. 1 Steel Work.

This work was covered by the Kansas City Structural Steel Co.'s contract. (See account 7308.20.) The bridge consisted of two girders—each of three 18-in. by 50-lb. by 20-ft. I-beams, connected with bolts and separators and anchored to the foundations with four 1-in. bolts.

Culvert No. 1**Account 7311—Culvert No. 1 Masonry.**

This was a stone culvert 534 ft. long, with inside dimensions 4 ft. by 4 ft. The top was built of old 50-lb. rails at \$15 a ton, spaced 8-in. centers and rendered tight with stones set with cement mortar in between rails. There is 20 ft. or more fill over the culvert at various points. The stones laid in cement mortar for the sides and bottom were obtained on the site.

Retaining Walls**Account 7312—Excavation.**

This was a long narrow cut through fill, earth, and sand and gravel. It was taken out with picks and shovels and transported 200 ft. with slips.

Account 7312.1—Concrete.

The concrete covered by this account was a wall of gravity section, 8 in. at the top, of various heights and 80 ft. long. The mixture used was 7 parts sand and gravel to 1 part cement, wheeled 50 ft. Half of the yardage was hand mixed and half machine mixed.

Account 7312.20—Masonry.

This wall was built of stone which was hauled to the site and was laid in cement mortar. The wall was 124 ft. long, 12 in. to 18 in. thick and from 2 to 5 ft. high.

40-Ton Track Scales on Calcine Track**Account 7313—Excavation.**

The excavation here covered was a small rectangular cut through tight, red soil, filled with large stones. It was picked, shoveled and wheeled in barrows 50 ft.

Account 7313.1—Foundation.

The concrete under this account was small walls about 30 ft. by 5 ft. by 22 in. and a 10-in. slab. It was mixed 7 parts sand and gravel to 1 cement by hand and wheeled 25 ft. to place. About twenty-six $\frac{3}{4}$ -in. bolts were set in the concrete. Eighty-five per cent. of the vertical surface of this concrete was formed. (See Fig. 9.)

Account 7313.20—Cost and Erection.

This account covers the cost of the material and its erection of one 40-ton track scale. The scale platform is 24 ft. long with one 4-ft. 8½-in. track passing over it. It has a type registering beam. The scales were furnished by Fairbanks Morse Co. Itemized, the material accounts stand as follows:

| | Cost | Freight | Total |
|--|-------|----------|----------------|
| 1 40-ton track scale complete..... | \$400 | \$116.86 | \$516.86 |
| 6-in. by 6-in. ties; 8-in. by 12-in. stringers. 2-in by 12-in. decking..... | | | 26.19 |
| 6-in. and 5-in. channels and 5-in. I-beams..... | | | 102.85 |
| Strap steel, bolts, pipe, hauling, etc..... | | | 64.95 |
| | | | <hr/> \$710.85 |

(See Fig. 9.)

Account 7313.30—Scale House.

Same as 7309.50—practically.

Trestles to Receiving Bins

Account 7314—Excavating.

This excavation covered two large abutments 6 ft. in the ground and 10 piers going about 15 ft. into the ground. The material excavated was earth and adobe. It was handled in the pier footings by a windlass.

Account 7314.1—Foundation.

The concrete here covered was in two large abutments and in 10 piers. The abutments were about 8 ft. by 16 ft. by 24 ft. and the piers 7 ft. by 7 ft. by 23 ft. Forty-eight $\frac{3}{4}$ -in. bolts were set in the concrete. Twenty per cent. of the vertical surfaces were formed. The concrete was mixed in proportions of 7 parts sand and gravel to 1 part cement. A large amount of boulders were used in the piers. The concrete was both hand and machine mixed, and was wheeled in barrows an average of 200 ft.

Account 7314.2—Steel Structure.

There were 109.53 tons of structural steel used here.

Account 7314.30—Woodwork.

The woodwork here was practically the same in every respect as 7308.50, with additional walkways of 2 by 12 planks, nailed to strips bolted to the steel.

16,920 ft. b.m. 8 by 8 ties and 6 by 6 guard rails.

10,286 ft. b.m. 2 by 12, 2 by 4, 4 by 4 walk and 27,206 ft. total b.m. railings was used.

(See Fig. 6.)

Receiving Bins

Account 7401—Excavation.

This work covered the digging of a number of piers 7 ft. by 7 ft. to a depth ranging from 16 ft. to 25 ft. into gravel. The dirt was easily dug but had to be handled from the lower half of the holes with windlasses. It was carted away at the top 225 ft.

Account 7402—Foundation.

Only 5 per cent. of this concrete was formed. The lower part was machine mixed in proportions of 12 gravel and sand to 1 cement, while the upper part was 6 to 1. It was wheeled 200 ft. to place. The top surfaces were trowel finished to a perfect elevation for receiving the steel.

Account 7403—Steel Structure.

There were 11.35 tons of corrugated and 341.74 tons of structural steel used here. (See account 7308.2. See Fig. 11.)

Account 7404—Gates.

This account covers the cost of material, unloading hauling, fabrication, alteration, and erection of 30 gates beneath the receiving bins. All cast-iron parts together with operating wheel, shaft and gate itself were purchased outright.

The chutes attached to the gates were fabricated in the new smelter shops. The parts were assembled in the field and there erected. The holes in the steel structure to which the gates were attached had to be rebored in the field. The counterweights for the 12 coarse ore-bin gates were made on the job and erected. These 12 counterweighted gates are opened by rack and pinion, operated by a hand wheel and cut up through the stream. The chutes to guide the ore to the feeder are of $\frac{3}{8}$ -in. plate, while the gate is $\frac{5}{8}$ in. The other 16 gates for the concentrate bin are similar to the above, but are not counterweighted and cut down through the stream. (See Fig. 12.)

Account 7405—Conveyor No. 1.

This account covers the entire labor and material connected with the installation of conveyor No. 1. It does not include the steel frame to which the idlers are attached, but does cover the cost and installation of the traveling feeder with the necessary ties, rails, wire and motor. This segregation of charges is true of all conveyor costs given in this Cost Sheet. All the conveyors were furnished by the Robins Conveying Belt Co. Conveyor No. 1 was a 30-in. belt, making a 97-ft. conveyor with a 3-ft. rise, operating at a speed of 150 ft. per minute, capable of handling 100 tons per hour. It is supplied with 12-in. material from the bins above it through a speeded feeder. (See Fig. 6.) The material account is segregated as follows:

| | Cost | Freight | Total |
|-----------------------------|----------|---------|-------|
| 202-ft. 30-in. belt..... | \$686.80 | \$46.45 | ..... |
| Feeder belt..... | 56.75 |  | ..... |
| Conveying idlers, etc..... | 1,497.12 | 185.09 | ..... |
| Cent. switch..... | 34.00 | 2.20 | ..... |
| Broken pulley..... | 44.00 |  | ..... |
| Miscellaneous material..... | 307.73 |  | ..... |
| One 5-h.p. motor | 87.05 |  | ..... |

\$2,713.45 \$222.74 \$2,936.19

Account 7406.01—Conveyor No. 22.

This conveyor is similar to No. 1. It has a 20-in. belt, making a conveyor 117 ft. long, with a 3-ft. rise, operating at a speed of 200 feet per minute with a capacity of 150 tons and taking $\frac{3}{8}$ -in. concentrates through a speeded feeder. The material account is segregated as follows:

| | Cost | Freight | Total |
|-----------------------------------|------------|----------|------------|
| 241-ft. 6-in. to 20-in. belt..... | \$432.38 | \$31.94 | , |
| Feeder belt..... | 56.75 | ..... | ..... |
| Robins material..... | 1,367.50 | 169.07 | ..... |
| Cent. switch..... | 34.00 | 2.21 | ..... |
| Miscellaneous material..... | 317.14 | ..... | ..... |
| 5-h.p. motor..... | 87.04 | ..... | ..... |
| | <hr/> | <hr/> | <hr/> |
| | \$2,294.81 | \$203.22 | \$2,498.03 |

(See Fig. 13.)

Account 7407—Lighting.

The receiving bins were lighted with 22 drop lights using 100 volts A. C. current.

Crushing Plant**Account 7701—Excavation.**

This was a large rectangular cut for the Crusher Building made through cemented sand and gravel, with streaks of soil running through the cut hardened by caliche. The work was done with pick and shovel and handled by wheelbarrow into carts and hauled 225 ft.

Account 7702—Foundation.

This concrete was reinforced with $\frac{1}{2}$ -in. and $\frac{3}{4}$ -in. round, medium steel rods. It was cast in walls, 12 in. thick, about 12 ft. high and as a 12-in. floor slab. The concrete was machine mixed in the proportions of 5 sand and gravel to 1 cement and about 60 per cent. of the vertical surfaces were formed. It was wheeled in barrows 400 ft. up an 8 per cent. grade.

Account 7703—Steel Structure.

There were 5.17 tons of corrugated iron and 19.90 tons of structural steel used. (See account 7308.2.)

Account 7703.1—Doors, Windows and Frames.

The material here used for openings was as follows:

| | |
|--|----------|
| 9 windows and frames 3 ft. 10 $\frac{1}{2}$ in. by 7 ft. 8 in., 24 lights. } | \$138.40 |
| 4 sash and frames, 2 ft. 11 $\frac{1}{4}$ in. by 3 ft. 11 $\frac{1}{4}$ in., 9 lights. } | |
| Balance, butts, catches, etc..... | 25.38 |
| Lumber for sills..... | 6.93 |
| | <hr/> |
| | \$170.71 |

Account 7703.2—Painting Woodwork.

All the woodwork was painted with two coats of lead and linseed oil in cream color.

Account 7704—Crushing Machinery.

This account covers the material cost and labor of installing the following machinery:

| | |
|---|------------|
| One 36-in. by 18-in. Farrell Crusher, second hand, weight | |
| 50,000 lb..... | \$1,000.00 |
| Miscellaneous lumber..... | 93.61 |
| | <hr/> |
| | \$1,093.61 |

Account 7704.1—Chutes.

This account covers the cost of material noted below, the labor of fabricating the spouts, hoppers, and their erection:

- 1 Grizzly screen 3 ft. by 8 ft. made of 1-in. bars, having 2½-in. by 2½-in. openings, framework made of ⅜-in. plate and 3-in. by 3-in. angles.
- 1 Spout for grizzly, dumping on conveyor No. 4 made of ⅜-in. steel plate and 2-in. by 2-in. by ½-in. angles. ¾-in. C.I. liners used.
- 1 Hopper for crusher made of ⅜-in. steel plates 2½-in. by 2½-in. by ¾-in. angles. ¾-in. C.I. liners used.

Account 7705—Shafting, Pulleys and Belting.

This account covers the material cost and erection of the following:

| | |
|---|----------|
| 1 Pc. shafting 4 ⅞ in. by 6 ft. 6 in. with two collars..... | \$29.64 |
| 1 Pc. shafting 4 ⅞ by 5 ft. 3 in..... | 16.51 |
| Two 4 ⅞-in. rigid pillow blocks..... | 58.55 |
| One 48-in. by 11-in. split pulley..... | 47.59 |
| One 36-in. by 16-in. split pulley..... | 43.71 |
| Two 4 ⅞-in. safety collars..... | 5.39 |
| 43 ft. 10-in. two-ply leather belt..... | 60.80 |
| 42 ft. 14-in. two-ply leather belt..... | 220.37 |
| Miscellaneous..... | 0.79 |
| | <hr/> |
| | \$483.35 |

Account 7706—Motor.

This account covers the cost of the following material and the installation:

| | |
|--|----------|
| One 50-h.p. Crocker-Wheeler squirrel-cage motor with starter | \$478.41 |
| Lumber for housing motor..... | 35.23 |
| | <hr/> |

\$513.64

Account 7707—Power Wiring.**Account 7707.1—Lighting.**

This account covers the cost and installation of the following material:

8 drops 16 candle power
30 ft. brewery cord
350 ft. No. 12 weatherproof wire
45 ft. 1-in. conduit.
Switches, bolts, etc.

Sampling Plant

Account 7801—Excavation.

This account covers the excavation of the sampling plant and the necessary backfill tamped in 5-in. layers in the low parts where the basement concrete floor was cast. It was done with picks, shovels and wheelbarrows, through earth, sand and gravel.

Account 7802—Foundation.

This concrete was cast in the walls and piers of the sampling plant. It was mixed by machine in the proportions of 7 parts sand and gravel to 1 part cement and wheeled in barrows 150 ft. Ninety per cent. of the vertical surfaces of the concrete was formed. The cost of all anchor bolts as well as the finish to exact level for building columns is included here.

Account 7802.1—Concrete Ground Floor.

This was plain concrete floor laid with sand joints in about 6-ft. square blocks 5 in. thick, in the proportions of 5 parts sand and gravel to 1 cement. The top finish was 1 in. thick, made 2 parts sand to 1 cement, troweled smooth. The concrete was mixed by machine and transported 175 ft. in barrows.

Account 7802.2—Reinforced Concrete Floors.

This concrete was cast over steel I-beams, using forms between the steel beams. The mix was the same as the above floor with the same top finish. The reinforcing used was Clinton welded fabric 2-in. by 12-in. mesh. The floor was 4½ in. thick. The concrete was mixed by machine and transported 500 ft. to place by wagon, wheelbarrow and hoist.

Account 7803—Steel Structure.

There were 13.46 tons of corrugated iron and 97.39 tons of structural steel used. (See account 7308.2.)

Account 7803.1—Doors, Windows and Frames.

This account covers the purchase price and erection cost of material enumerated below. The doors are not given in the list, as they were made upon the job, but correspond to the frames noted. Necessary hardware is also included in the cost.

Fourteen 24-light windows 3 ft. 9½ in. by 7 ft. 8 in. by 1½ in.
with frames

Twenty-nine 40-light windows 7 ft. 5½ in. by 3 ft. 10½ in. by
1½ in. with frames

Two 9-light windows 2 ft. 11 $\frac{1}{4}$ in. by 3 ft. 11 $\frac{3}{4}$ in. by 1 $\frac{3}{8}$ in.
with frames

One 4-ft. 8-in. by 7-ft. 4-in. door frame

One 9-ft. 2-in. by 8-ft. 10-in. door frame

Three 4-ft. 8-in. by 7-ft. 4-in. door frames

Five 3-ft. 8-in. by 7-ft. 4-in. door frames

One 3-ft. 8-in. by 7-ft. 2-in. door frame

One 9-ft. 2-in. by 9-ft. 2 $\frac{1}{2}$ -in. door frame

\$564.90

(See Fig. 14.)

Account 7803.11—Painting Doors and Windows.

This covers the material and labor of applying two coats of linseed oil and white lead.

Account 7804—Shafting, Pulleys and Belting.

This is not a good cost. The labor is unquestionably too low and has been absorbed by some of the following accounts up to account 7807.5. Eighty-five feet of shafting, varying in size from 1 $\frac{5}{16}$ in. to 3 $\frac{7}{16}$ in. with 28 pulleys of various diameters and face with the various hangers, collars, etc., and 1,325 ft. of 3-in. to 12-in. leather belting were to be taken care of here. The material is correct. (See Fig. 108.)

Account 7805—Motors.

The material covered by this account is as follows:

| | |
|--------------------------------------|----------|
| One 15-h.p. squirrel-cage motor..... | \$189.94 |
| One 75-h.p. slip ring..... | 644.00 |
| Overload release..... | 14.25 |
| Miscellaneous..... | 39.38 |
| | <hr/> |
| | \$887.57 |

Account 7806—Power Wiring.

Account 7806.1—Lighting.

| | |
|---|----------|
| 36 drop lights..... | |
| No. 12 weatherproof wire used in conduit..... | \$140.57 |

Account 7807—Rolls and Samplers, Cost and Erection.

This cost covers the price and installation of the following material, together with the application of two coats of Dixon's Silica Graphite paint upon the Rolls, Samplers and Chutes:

| | Cost | Freight | Total |
|--|------------|----------|------------|
| 2 sets 24 by 12 rolls, from Chalmers and Williams..... | \$1,330.00 | \$344.16 | \$1,674.16 |
| 1 set 42 by 16 rolls, from Chalmers and Williams..... | 1,567.50 | 482.40 | 2,049.90 |
| 1 set 48 by 12 rolls, from Chalmers and Williams..... | 1,710.00 | 716.43 | 2,426.43 |
| One 27-in. Snyder sampler with 28-in. by 3 $\frac{1}{2}$ -in. pulley T. & L..... | 38.00 | 5.04 | 43.04 |

| | Cost | Freight | Total |
|---|--------|---------|--------|
| Two 42-in. Snyder samplers with 40-in. by 3½-in. pulley T. & L..... | 133.00 | 29.95 | 162.95 |
| 1 No. 1 Vezin sampler with spout arranged for 5 per cent. cut, Allis-Chalmers..... | 162.00 | 20.51 | 182.51 |
| 1 No. 3 Vezin sampler with spout arranged for 10 per cent. cut, Allis-Chalmers..... | 220.00 | 45.64 | 265.64 |

| | Cost | Freight | Total |
|--|----------|---------|----------|
| Two 5-T steel plate crawls for 12-in. I's... | \$104.00 | \$15.76 | \$119.76 |
| One 4-T steel plate crawls for 10-in. I's... | 40.00 | 6.11 | 46.11 |
| Two 3-T steel plate crawls for 9-in. I's... | 64.00 | 8.61 | 72.61 |
| One 5-T Triplex chain block..... | 112.00 | 14.49 | 126.49 |
| One 4-T Triplex chain block..... | 88.00 | 9.10 | 97.10 |
| Structural steel, machine parts..... | | | 632.44 |

Miscellaneous, etc..... \$7,899.14
(See Figs. 15, 16, 110, 111 and 112.)

Account 7807.10—Cast Iron Liners and Drying Pan, and Erection of Chutes.

This account covers the erection of account 7807.5, and the cost and erection of the following:

| | |
|---|------------|
| 1 Sample drying pan 8 ft. ½ in. by 5 ft. 2½ in..... | \$136.11 |
| ¾-in. C.I. liners for chutes, castings c..... | 865.75 |
| | <hr/> |
| | \$1,001.86 |

Account 7807.20—Elevators.

Below is a description of the elevator with the material cost. The erection is too low and not usable.

| | |
|---|----------|
| 33 ft. between head and tail shafts | |
| Head and tail pulley 34 in. by 9 in. | |
| Drive pulley 23 in. by 6 in., 40 h.p.m. | |
| All housed with No. 10 plate steel casing | |
| 72 ft. 6 in. of 8-in. 6-ply rubber belt | |
| Forty-eight 6-in. by 4-in. malleable buckets, style A.A. Mfrs. std. | |
| Liners for casing made of white iron ¾ in. and 1 in. thick | |
| Cost..... | \$458.22 |
| (See Fig. 11.) | |

Account 7807.5—Steel Chutes.

This is the average cost per pound of material and labor for fabricating all steel chutes used in the sample mill. In general they were made of ⅜-in. plate and light angles. The cost of erecting is in 7807.1 and in the comparative costs are found the individual chute costs. (See Fig. 109.)

Account 7809—Keystone Plate Partitions.

1,523 sq. ft. of No. 14 Keystone Plate partitions were erected by riveting the plates together and attaching them to the structural steel of the building. The plates were originally intended for a roof upon the Roaster Dust Chamber and had each long edge turned up $1\frac{1}{2}$ in. The cost of cutting these edges off is here included. (See Fig. 113.)

Account 7810—Alteration of Chutes and Machinery.**Bedding Plant and Bunker Bins****Account 7901—Excavation.**

This excavation involved making long, deep, oblong cuts through earth and sand and gravel bonded with caliche. It was necessary to use power to shake up the ground, followed in some cases with plows. A part of the work was handled with slips and fresnos; another part by picks, shovels and wagons. The average haul was 600 ft.

Account 7902—Foundation.

This concrete yardage was made up as follows:

| | |
|---|--|
| 550 ft. footing, 4 ft. wide by 2 ft. deep—plain | |
| 550 ft. wall, 1 ft. 6 in. thick by 5 ft. high—plain | |
| 1200 ft. footing, 3 ft. 6 in. wide by 10 in. deep—plain | |
| 600 ft. wall, 1 ft. 6 in. thick by 6 ft. high—plain reinforced coping | |
| 600 ft. wall, 1 ft. 6 in. thick by 11 ft. high—plain | |
| 320 ft. footing, 7 ft. wide by 3 ft. deep, reinforced with $\frac{3}{4}$ -in. and $\frac{1}{2}$ -in. rods, 6 in. on centers | |
| 320 ft. wall, 4 ft. 5 in. thick by 11 ft. high, reinforced with $\frac{3}{4}$ -in. rods, 12 in. on centers | |
| 12,700 sq. ft. rough finished slab, 5 in. thick | |

The concrete, of which 85 per cent. of the vertical surface was formed, was machine mixed, in the proportions of 7 parts sand and gravel to 1 part cement. It was wheeled to place in barrows, a distance on the average of 180 ft. About half of the yardage was reinforced.

Account 7903—Steel Structure. (See account 7308.2.)

| | |
|------------------------|-------------|
| Structural steel | 510.41 tons |
| Corrugated iron..... | 38.30 tons |
| | <hr/> |
| | 548.71 tons |

(See Fig. 114.)

Account 7904—Conveyors 7¹, 7². (See account 7405, and Fig. 91.)

Conveyor 7¹ has a 20-in. belt, 180 ft. 3 in. from center line to center line of head and tail pulleys with an 8-ft. 9-in. rise, operating at a speed of 300 feet per minute, with a capacity of 150 tons per hour. It takes $\frac{3}{8}$ -in. material which it unloads through a 20-in. automatic tripper. It brings the fines from the Conveyor 5 to the bedding conveyors. Conveyor 7² has a 20 in. belt, 200 ft. long from center line to center line of head and tail pulleys with a 9-ft. 2-in. rise, operating at a speed of 400 feet per minute, capable of handling 100 tons per hour. It takes $2\frac{1}{2}$ -in. material from Conveyor 6 which it unloads through an automatic tripper into the Bunker Bins beneath. The original installation here called for a bedding tripper at \$950, which was superseded by an automatic tripper. Both charges are in this account. For a proper unit cost here, this charge of \$950 should be deducted.

The woodwork noted below in the segregated charges includes walkways of two 2 by 12's beside both conveyors, as well as decking.

| | Cost | Freight | Total |
|---|------------|----------|-------------------|
| Belts..... | \$1,433.79 | \$102.35 | \$1,536.14 |
| Conveyor material..... | 1,451.06 | ..... | ..... |
| 2 automatic trippers and track (used)..... | 1,228.38 | 369.02 | 3,998.46 |
| 1 ore bedding tripper (discarded)..... | 950.00 | ..... | ..... |
| Lumber..... | ..... | ..... | 253.74 |
| 7½-h.p. motor conveyor 7 ¹..... | ..... | ..... | 138.75 |
| 10-h.p. motor conveyor 7 ²..... | ..... | ..... | 156.80 |
| Centrifugal switch..... | ..... | ..... | 72.40 |
| Drive Belts..... | ..... | ..... | 54.80 |
| Wire for motors..... | ..... | ..... | 97.26 |
| Painting material..... | ..... | ..... | 20.88 |
| Miscellaneous..... | ..... | ..... | 44.44 |
| Total..... | ..... | ..... | <u>\$6,373.67</u> |

Account 7904.1—Conveyors 8¹, 8², 8³.

(See account 7405.)

Conveyors 8¹, 8², 8³ are practically identical, running out over the three beds. The exception is that conveyor 8³ has a 6-ft. in place of a 3-ft. rise at the start and is 5 ft. longer. In general the three belts are 20 in. wide, 186 ft. 9 in. long, from center line to center line of head and tail pulleys, with a 3-ft. rise, operating at a speed of 400 ft. per minute, with a capacity of 150 tons per hour, taking a $\frac{3}{8}$ -in. material and distributing it through a bedding tripper onto the beds below. This account segregated shows as follows:

| | Cost | Freight | Total |
|--------------------------------|------------|----------|------------|
| Belts..... | \$2,124.73 | \$152.34 | \$2,277.07 |
| Conveyer material..... | 1,793.55 | ..... | ..... |
| 3 ore bedding trippers..... | 2,850.00 | 569.53 | 5,213.08 |
| Lumber, walkways, decking..... | ..... | ..... | 237.13 |
| Three 15-h.p. motors..... | ..... | ..... | 569.82 |
| Centrifugal switch..... | ..... | ..... | 108.60 |
| Drive belts..... | ..... | ..... | 72.41 |
| Electrical supplies..... | ..... | ..... | 145.89 |
| Painting material..... | ..... | ..... | 31.32 |
| Miscellaneous..... | ..... | ..... | 63.66 |
| Total..... | ..... | ..... | \$,718.98 |

(See Fig. 91.)

Account 7904.2—Conveyors 9¹, 9², 9³, 10¹, 10².

(See account 7405.)

All these conveyors are on wooden supports, the material for which and the cost of walkways is here included.

Conveyors 9¹, 9², 9³ are identical. They take the reclaimed material from the beds to conveyor 10¹. They are 20-in. wide belts, 198 ft. 4 in. from center line of head pulley to center line of tail pulley perfectly flat, operating at a speed of 300 feet per minute, with a capacity of 100 tons per hour.

Conveyor 10¹ takes the material from 9¹, 9², 9³ to conveyor 11. It is 145 ft. 3 in. from center line of head pulley to center line of tail pulley, perfectly flat, operating at a speed of 300 feet per minute, with a capacity of 100 tons per hour.

Conveyor 10² takes the material from the Bunker Bin gates to Conveyor 14. It has a 20-in. belt, is 165 ft. long from center line of head pulley to center line of tail pulley, is perfectly flat, operating at a speed of 300 feet per minute, with a capacity of 100 tons per hour. It uses one feeder below the gates the same as on Conveyor 2.

The material segregated is as follows:

| | Cost | Freight | Total |
|---|------------|----------|------------|
| Belt..... | \$3,300.76 | \$228.98 | \$3,529.74 |
| Feeder belt on 10 ²..... | ..... | ..... | 56.76 |
| Conveyor material..... | 2,718.25 | ..... | ..... |
| Feeder conveyor 10 ² | 925.00 | 586.43 | 4,229.68 |
| Lumber for walkways, decking, framework, etc..... | ..... | ..... | 755.61 |
| 5 overload releases..... | ..... | ..... | 71.25 |
| 5 centrifugal switches..... | ..... | ..... | 181.05 |
| Five 5-h.p. motors..... | ..... | ..... | 435.20 |
| Drive belts..... | ..... | ..... | 106.28 |
| Electrical supplies..... | ..... | ..... | 243.13 |
| Painting material..... | ..... | ..... | 52.19 |
| Miscellaneous..... | ..... | ..... | 95.30 |
| Total..... | ..... | ..... | \$9,756.19 |

(See Fig. 115.)

Account 7904.3—Bunker Bin Gates.

These are cast-iron chutes about 22 in. square with an arc gate controlling the discharge through the bottom. All cast iron is $\frac{3}{4}$ -in. thick, save the $\frac{5}{8}$ -in. wearing plate upon the arc gate. The operating lever was furnished in the structural steel contract.

42 spouts $\frac{3}{4}$ -in. cast iron

42 gates $\frac{3}{4}$ -in. cast iron

42 cover plates $\frac{5}{8}$ -in. cast iron

\$1,021.64

Account 7904.4—Chutes for Conveyors 7¹ to 10² inc.

This account covers the fabrication, erecting and material in the chutes directing the ore from one belt to another at the Beds and Bunker Bins. Also included here are the cast-iron wearing plates for lining the Chutes.

The chutes are made of $\frac{3}{16}$ -in. plate and the necessary angles. The wearing plates are $\frac{3}{4}$ in. to 1 in. thick, hard, white cast iron.

Account 7905—Two Reclaimers.

(See Fig. 116.)

Account 7905.1—Two Reclaimers Wiring.

This account covers the material cost and labor of installing a double trolley wire on three beds together with the wiring of two reclaimers and switchboards. The material is wire, condulets, circuit breakers, and the like. (See Fig. 118.)

Account 7906—Lighting.

This account covers the labor and material used in lighting the Bedding Plant and Bunker Bins.

63 carbon lamps, 16 candle power

455 ft. brewery cord

1,395 ft. No. 8 weatherproof wire

1,835 ft. No. 12 weatherproof wire

205 ft. $1\frac{1}{2}$ -in. conduit

285 ft. 1-in. conduit.

Account 7907—Transfer Car.

This car was a structural steel frame about 4 ft. high and 62 ft. by 18 ft. in plan. It transfers the Reclaimers from one bed to another, or to the repair shed under its own power, using a $7\frac{1}{2}$ -h.p. motor, getting direct current through a trolley. It was furnished by the Robins Conveying Belt Co. (See Fig. 117.)

Account 7908—Signal System.

This account is of no value.

Roasting Plant

Account 8101—Excavation.

This covered a large surface grade made to the required elevation of the site, made by plows and frescos and hauling the dirt to a railroad grade an average of 450 ft. This was followed by picks, shovels and carts, making deep cuts to gravel through red clay and boulders for the steel foundation.

Account 8102—Foundations.

This concrete was all cast as piers with at least 2 $\frac{3}{4}$ -in. bolts in each pier. Only 10 per cent. of the vertical surfaces was formed, though many of the piers were 6 ft. deep. One-half of the concrete was machine mixed and one-half was hand mixed in the proportions of 7 parts sand and gravel to 1 cement. The pier tops were finished to a perfect elevation to receive the steel columns. The concrete was wheeled about 60 ft.

Account 8103—Steel Structure.

(See account 7308.2.)

There were 23.16 tons of corrugated iron and 422.12 tons of structural steel used. (See Figs. 117 and 118.)

Account 8103.1—Elevator.

This account gives the entire labor and material incident to erecting a 52-ft. high 10-ft. 6-in. by 8-ft. 6-in. platform elevator in a self-supporting structural steel frame. It does not include other than the excavation and concrete pit. The account segregated stands thus:

| | |
|--|------------|
| Structural steel erected for elevator frame and tower..... | \$840.97 |
| One 5-T electric hoist with 240-volt D.C. motor..... | 1,261.60 |
| 3,792 b.f. lumber..... | 11.56 |
| Rope sheaves, counterweights, etc..... | 29.23 |
| Labor..... | 37.79 |
| Miscellaneous..... | 8.47 |
| | <hr/> |
| | \$2,189.62 |

The labor installed the motor, hoist and wood platform.

Account 8104—Roasters, Cost and Erection.

This account covers the cost and erection of the roaster shells as furnished by the Kansas City Structural Steel Co. and the roaster equipment, namely, the central shaft, rabble arms, rabbles, driving mechanism, doors to roasters, cast-iron rings, etc. As segregated the material account shows below. The Herreshoff furnaces have 6 super-imposed hearths and a top drying hearth. The arms are cooled by air furnished by two motor-driven fans. The diameter of the shell is 21 ft. 7 $\frac{1}{4}$ in. outside and 18 ft. 2 in. in height.

| | Cost | Freight | Total |
|---|-------------|------------|-------------|
| 8 furnaces from Pacific Foundry Co. designed by Gen. Chemical Co. \$36,278.12 | \$36,278.12 | \$8,016.73 | \$44,294.85 |
| Eight 1-ton steel trolleys for 6-in. I's..... | | | 155.30 |
| (See Fig. 121.) | | | |
| One 1-ton duplex chain block..... | | | 27.47 |
| Steel shells erected—KCSSCo..... | 10,192.73 | 840.06 | 11,032.79 |
| Power for riveting..... | | | 452.25 |
| Miscellaneous..... | | | 363.43 |
| | | | <hr/> |
| | | | \$56,326.09 |

Account 8104.1—Roaster Alteration.

Account 8105—Brickwork.

This account covers the cost of the brick, mortar materials, etc., and labor of the mason with helpers of installing the brick in the roasters. The unloading of the brick from cars, the centers and carpenter labor are taken care of elsewhere. The brick here used were in the main special shapes and 95 per cent. of them were hard burned red brick. In all there were 15 different shapes. The hearths were laid dry and the shell brick laid with slimes from the copper company's concentrator. (See Fig. 133.)

Account 8105.01—Brick Unloading.

This covers the cost of leveling ground, checking up quantities, and unloading of brick from cars to roasters. This total cost includes the unloading of all brick for roaster use, the actual amount needed plus the extra not used.

Account 8105.02—Brickwork Centering.

This account covers the cost of making, installing, removing and the material for 16 sets of centers used for putting in 48 hearths. (See Fig. 133.)

Account 8106.01—Roaster Flue-spouts.

This covers the cost of material and erection of 10 spouts with gates from the roasters' common flue. The material is as follows:

10 cast-iron gates for 12 $\frac{1}{4}$ in. diameter spouts.

10 spouts of No. 10 plate, 24 ft. long, 12 $\frac{1}{4}$ in. outside diameter fastened to base of hopper by 2 in. by 2 in. angle collar.

10 $\frac{3}{8}$ in. plate slides for gates.

(See Fig. 135.)

Account 8106.02—Tile Work.

This account covers the mason labor, carpenter labor, cost of tile and unloading, mortar materials and a lumber charge for scaffolds used in this flue. The flue is built of tile and is about 50 ft. from the ground. The tile for the roof was laid between T iron spanners from wall to wall. The mortar was lime. (See Fig. 132.)

Account 8106.03—Painting Flue.

The inside of the above flue was given one coat of silicate of soda. The account covers this material and labor cost.

Account 8107—Shafting, Pulleys and Belting.

Below is the material list erected under this account. The shafting was attached directly to the steel frame of the building.

| | | | |
|---|---|-------|------------|
| 47 ft. of 3 $\frac{3}{16}$ -in. shafting | } | ..... | \$1,500.50 |
| 103 ft. of 2 $\frac{1}{16}$ -in. shafting | | | |
| Two 20-in. by 12-in. pulleys | | | |
| One 36-in. by 10-in. with clutches for each Roaster | | | |
| 150 ft. 10-in. 6-ply rubber belt | } | ..... | 471.85 |
| 310 ft. 8-in. 7-ply rubber belt | | | |
| Miscellaneous | | | |
| | | | 27.54 |
| | | | <hr/> |
| | | | \$1,999.89 |

Account 8108—Motor.

This covers the cost of material and labor of installing one 30-h.p. motor to drive the Roasters. It is located directly upon the first steel floor of the Roaster Building.

| | |
|--|----------|
| One 30-h.p. squirrel-cage motor..... | \$267.80 |
| One overload release..... | 14.25 |
| Miscellaneous wire, insulators, belt, etc..... | 181.91 |
| | <hr/> |
| | \$463.96 |

Account 8109—Lighting.

The Roasters are furnished with light on all floors.

Account 8112—Motor-driven Fans.

This covers the price and cost of installing upon their foundations 2 motor-driven fans, which furnish the air to cool the roaster arms. They are 55-in. double width, full housing conoidal fans, direct connected, each with a 25-h.p. squirrel-cage induction motor.

Each fan has a capacity of 22,000 cu. ft. of air per minute against a pressure of 1 $\frac{3}{4}$ in. water.

| | Cost | Freight | Total |
|------------------------|------------|----------|------------|
| 2 fans and motors..... | \$1,203.00 | \$199.49 | \$1,402.49 |
| Miscellaneous..... | | | 3.42 |
| | | | <hr/> |
| | | | \$1,405.91 |

Account 8112.1—Blast Pipe.

This account covers the material price, cost of fabrication and installation of 240 ft. of blast pipe. The installation referred to is connecting up and riveting the pipe in place in the field only. The pipe is made of No. 10 and No. 12 plate and varied in diameter from 18 in. to 36 in. The inlet pipe to each roaster was 18-in. diameter.

Account 8113—Conveyor No. 12.

See account 7405. This conveyor takes the material of the beds from conveyor No. 11 and delivers it to conveyor 13¹ and 13². It is a 20-in. belt, 51 ft. 3 in. from center line of tail pulley to center line of head pulley, with an 8-ft. rise, operating at a speed of 300 ft. per minute, with a capacity of 100 tons per hour. The segregated material account is as follows:

| | Cost | Freight | Total |
|--|----------|---------|----------------|
| Belt..... | \$209.43 | \$14.43 | \$223.86 |
| Conveyor material..... | 370.91 | 45.86 | 416.77 |
| One 5-h.p.m..... | | | 87.04 |
| 1 centrifugal switch..... | 34.00 | 2.21 | 36.21 |
| Lumber, decking and painting material..... | | | 30.97 |
| Spout conv. 11 to conv. 12..... | | | 7.70 |
| Miscellaneous..... | | | 2.50 |
| | | | <hr/> \$805.05 |

Account 8113.1—Conveyors 13¹ and 13².

Conveyors 13¹ and 13² take the product from conveyor 12 running the length of the Roaster Building each delivers the material through a separate automatic tripper to the roaster bins. They are identical. Both are 20-in. belts, running perfectly flat, 109 ft. from center line of head pulley to center line of tail pulley, operating at a speed of 300 ft. per minute, with a capacity of 100 tons per hour. The account for material stands as follows:

| | Cost | Freight | Total |
|-----------------------------------|----------|---------|------------------|
| Belt..... | \$837.72 | \$59.26 | \$896.98 |
| Conveyor material..... | 913.60 | 236.45 | 2,150.05 |
| 2 automatic trippers & track..... | 1,000.00 | | |
| Two 5-h.p. motors..... | | | 174.08 |
| 2 centrifugal switches..... | 68.00 | 4.42 | 72.42 |
| Drive belt..... | | | 30.79 |
| Lumber, decking, paint..... | | | 123.90 |
| Spouts from conveyor 12..... | | | 11.54 |
| Miscellaneous..... | | | 12.57 |
| | | | <hr/> \$3,472.33 |

(See Fig. 91.)

Account 8113.2—Stile over Conveyors 13¹ and 13².

These stiles were made of structural steel, purchased from the Kansas City Structural Steel Co. and erected by the Arizona Copper Co.

Roaster Dust Chamber**Account 8121—Excavation.**

Same as 8101.

Account 8122—Foundation.

Same as 8102.

Account 8123—Steel Structure.

See account 7308.2.

There were 14.8 tons of corrugated iron, 376.4 tons of structural steel used here and 27.63 tons of No. 11 Keystone plate. (See Figs. 103 and 131.)

Account 8123.01—Wire Baffles.

This account covers the cost of material, labor, and repairs entailed in installing 60,480 wire baffles in the roaster dust chamber. The wires with hooks on one end like shepherds crooks were hung 4 in. on centers both ways from chains supported from the lower members of the roof trusses 4 in. apart. The segregation of material is as follows. The wires hung a few inches off the dust chamber bottom and were thus of various lengths. (See Fig. 131.)

| | |
|---|------------|
| 1,008 $\frac{3}{8}$ -in. chains 20 ft. 6 in. long with two hooks..... | \$1,451.00 |
| 63,964 lb. No. 10 wire (black)..... | 2,877.82 |
| 6,557 lb. No. 10 wire (black)..... | 361.96 |
| Miscellaneous..... | 67.35 |
| | <hr/> |
| | \$4,758.23 |

(See Fig. 131.)

Account 8123.1—Tile Work.

The sides of the roaster dust chamber and inclined bottom were built of 4-in. hollow tile. This material, labor of masons and their helpers, lumber for scaffolds, carpenter labor, mortar, material and power for hoisting are here included in the cost.

Account 8123.11—Tile Unloading.

This account covers the cost of unloading, wheeling, checking quantities and leveling up ground to receive tile.

Account 8123.2—Painting Outside.

The outside of the tile portion of the chamber, namely, sides and bottom, were given one coat of mineral red and linseed oil. The mortar was scraped from the tile before applying. This account covers the labor and material.

Account 8123.3—Painting Inside.

The tile work on the inside of the dust chamber was given one coat of silicate of soda used as a paint. This account covers the labor and material of this operation.

Reverberatory Plant

Account 8301—Excavation.

This was the making of a deep surface cut for the building. The material was principally red clay and boulders. In many cases power was used. In general the ground was plowed, scraped with fresnos through a trap into narrow-gauge side-dump cars and hauled, 2,000 ft. by steam locomotive to make a railroad fill.

Account 8301.01—Backfilling.

This covers the cost of backfilling in the reverberatory bottoms and between the reverberatories. The dirt was red clay soil. It was plowed, hauled in wagons, dumped, shoveled into a derrick box and lifted by a locomotive crane over the reverberatory sites and dumped. It was then distributed with wheelbarrows and tamped in 4-in. layers.

Account 8302—Foundation.

This work consisted of long walls averaging 230 ft. long 4 ft. at top and 6 ft. at bottom, and of beams to withstand the reverberatory buck stay pressure, averaging 660 ft. long by 3 ft. by 3 ft. The walls were reinforced with $\frac{3}{4}$ -in. rods, spaces about 4 to 6 in. on centers, while the beams were reinforced with $\frac{3}{4}$ -in. and 1-in. rods about 4 in. center lines one way.

The mixture used was 1 part cement and 5 parts sand and gravel, machine mixed, transported 100 ft. average, with wagons, cars, wheelbarrows and concrete carts as the situation demanded. 100 per cent. of the vertical surface was formed.

Account 8302.1—Concrete Counterweights.

These are used for the cross and header flues. Some are 1 ft. square from 6 ft. to 10 ft. long, cast in wooden forms. Others are circular, cast in steel cylinders. The concrete was mixed in a machine, wheeled 150 ft. and made plain with 1 part cement to 5 sand and gravel.

Account 8303—Steel Structure.

There is in this building 55.31 tons of corrugated iron, and 405.78 tons of structural steel.

Account 8304.—Reverberatories—Brickwork.

This account covers all the brick, mortar material and mason labor used in laying the brick of three reverberatories. The overall dimensions of the furnaces are 104 ft. long by 27 ft. wide and about 10 ft. 6 in. to the crown of the arch. The side walls are 2 ft. 6 in. thick and the arch is 20 in. deep. In the three reverberatories there was used 106,350 red brick, laid in lime mortar and 257,288 various shaped silica brick dipped in silica slimes. (See Figs. 77, 78 and 79).

Account 8304.01—Unloading Brick.

This account covers the cost of preparing the unloading site, building three brick sheds of 84,000 cu. ft. capacity, the unloading of the brick, checking the quantities, and piling separately 31 different shapes.

Account 8304.02—Centering.

This account covers the cost of material, fabrication of one center together with the labor and erecting and tearing it down three times. The arch was made of 2 by 12 centers with 1-in. sheathing tacked on top. The 2 by 12 centers were spaced 18 in. centers, supported on 6 by 8 stringers held up by 4 by 8 posts suitably braced. (See Fig. 130.)

Account 8304.05—Rehandling Brick.

This account covers the transporting at many different times of the silica brick from the sheds to the reverberatories a distance of 500 ft. by one-mule carts.

Account 8304.1—Steel Work.

This account covers the cost of the material and labor of installing the steel buck stays for the reverberatories. Below is a list of material:

| | |
|--|------------------------------------|
| Buck stays | 276 12-in. 31.5-lb. beams on sides |
| Buck stays | 84 12-in. 31.5-lb. beams on ends |
| Rails | 1,212-ft. 60-lb. rails |
| Rails | 594-ft. 75-lb. rails |
| Cross stay rds. | 78 1½ in. diam. 31 ft. 8 in. long |
| Longitudinal rds. | 27 1½ in. diam. 110 ft. |
| 6 steel supports for longitudinal rods made of 2 to 8-in. angles 11½ lb. | |
| (See Fig. 78.) | |

Account 8304.2—Silica Fill.

This cost is for the silica purchased, crushed in a variety of ways, transported to the furnaces and tamped in place there in layers. It came from the Calumet and Arizona Mining Co., at Douglas. The segregation of the account per ton is as follows:

| First cost | Freight | Crushing and placing | Total |
|------------|---------|----------------------|--------|
| \$2.757 | \$1.749 | \$3.134 | \$7.64 |

Account 8304.3—Hoppers and Chutes.

This account covers the cost of material and the installation of feed hoppers and chutes with their gates and levers to the reverberatories.

| | |
|--|------------|
| Cast-iron hoppers, chutes, weights, levers, bars..... | \$1,216.20 |
| 300 ft. ¼-in. steel sash cord, 100 clips, 50 thimbles..... | 23.00 |
| 102 lb. ½ by 3 flat iron..... | 2.45 |
| 200 lb. 1½-in. shafting..... | 12.09 |
| Miscellaneous..... | 9.85 |

\$1,263.59

(See Figs. 81 and 82.)

Account 8305 Cross and Header Flues Brickwork.

This covers the cost of the tile, brick, mortar, lumber for scaffolds, mason and carpenter labor incident to building the cross and header flues from the reverberatories to the boilers. They are 11 ft. from the ground and 8 ft. by 8 ft. 6 in. in section. The roof is a brick arch held by buck stays. There were red brick, fire brick and 4-in. bottom tile used in the construction. (See Figs. 80, 83, 84 and 85.)

Account 8305.1 Cross and Header Flues Unloading Brick.

This covers the unloading, checking quantities and preparing site for the brick used in the flues.

Account 8305.02 Cross and Header Flues Centering.

This covers the cost of material and labor for making, installing and wrecking the arch center for the flues of 8305.01. Centers were made for about one-half the length and then moved to the other half.

Account 8305.2 Cross and Header Flues Painting Brick.

This covers the cost of painting the outside of the flues with one coat of mineral red and linseed oil when the flues were in service. The steel work of the buck stays was given at the same time one coat of graphite paint.

Account 8306 Flues, Boilers to Reverb. Flue Excavation.

This work covers small pier excavation in red clay. It was picked, shoveled into barrows and transported about 15 ft.

Account 8306.1 Flues, Boilers to Reverb. Flue Foundation.

This foundation is some small piers of plain concrete mixed by machine, 1 part cement to 6 parts sand and gravel, transported by wheelbarrows 125 ft. About 40 per cent. of the vertical surfaces was formed. Every pier has 2½-in. anchor bolts.

Account 8306.2 Flues, Boilers to Reverb. Flue Steel Structure.

See account 7308.2.

This covers seven 6-ft. diameter flues of ¼-in. steel with their supports. There were 34.78 tons.

Account 8307 Boiler Building Excavation.

This account covers the digging of two long deep cuts for retaining walls. Two feet of clay were encountered, followed by sand and gravel and boulders with caliche. The ground was partly blasted, all picked, shoveled into wagons and hauled a distance of 600 ft.

Account 8307.01 Waste Heat Boilers Excavation.

This work was digging shallow trenches for small foundations, through red clay and small boulders. The ground was picked, shoveled and hauled 600 ft.

Account 8307.02—Oil-fired Boilers—Excavation.

Same as 8307.01.

Account 8307.05—Boiler Feed Pumps—Excavation.

This was a deep square cut involving 659 cu. yd. through red clay and boulders, into sand, gravel and boulders tightened with caliche. It was partly loosened with powder, picked, shoveled and hauled by wagons 400 ft. The lower half was handled twice, once onto scaffolds and the second time out of the pit.

Account 8307.04—Backfill, Back of Boiler Wall.

This was filling behind a long retaining wall. This dirt was adobe, wetted and tamped in 5-in. layers. The dirt was wheeled 60 ft. to place.

Account 8307.1—Boiler Building—Foundations.

This work covered a reinforced wall 240 ft. long, 11 ft. high, 1 ft. at top, 2 ft. at bottom, with pilasters connected at top with horizontal reinforced concrete beams forming the support for waste heat and oil-fired boilers. Three-fourth inch and $\frac{7}{8}$ -in. rods spaced about 6 in. to 8 in. were used together with many foundation bolts. The mixture was 5 sand and gravel to 1 cement, made in a machine and hauled 175 ft. in wagons, thence by wheelbarrow 10 to 15 ft. into place. One hundred per cent. of the vertical surfaces was formed.

Account 8307.11—Waste Heat Boilers—Foundations.

This work covered the reinforced concrete beams noted in 8307.1 required for the waste heat boilers. The other conditions were the same, save 50 per cent. only of the vertical surfaces was formed.

Account 8307.12—Oil-fired Boilers—Foundations.

See account 8307.11.

Account 8307.13—Feed Pumps—Foundation.

This account covered the reinforced cantilever walls for a pit 26 ft. by 26 ft. in plan, 14 ft. high and 1 ft. thick. The rods were $\frac{1}{2}$ in. and $\frac{3}{4}$ in. The mixture was machine mixed 5 sand and gravel to 1 cement, hauled 175 ft. in wagons to place. Seventy-five per cent. of the vertical surfaces was formed.

Account 8307.2—Floor over Slag Track Cut—Floor.

This covered the laying of a 6-in. reinforced concrete floor 30 ft. by 240 ft. over steel I-beams with a mortar finish troweled smooth. The mix was machine made 5 sand and gravel to 1 cement, with 2 to 1 top finish. A $\frac{3}{8}$ -in. woven wire triangular mesh was used and 50 per cent. of the surface was formed. The concrete was wheeled in barrows an average of 175 ft. (See Fig. 86.)

Account 8307.3—Floor around Boilers.

This is a 4,000-sq. ft. plain concrete floor of 4 in. laid in blocks with sand joints and given a 2 to 1 top finish. The concrete was machine mixed, 7 sand and gravel to 1 cement and wheeled in barrows about 175 ft. on the average.

Account 8308—Boiler Building—Steel Structure.

See account 7308.2.

There is in this building 35.03 tons of corrugated iron and 257 tons of structural steel.

Account 8308.5—Platforms and Brackets.

These were structural steel walkways installed after the boilers had been piped and bricked, furnished by the Kansas City Structural Steel Co. and erected by the Arizona Copper Co. construction force. There were 29.5 tons of material. The installation necessitated boring for connections and much removing steam piping.

Account 8309—Waste Heat Boilers, Including all steel.

This account covers the cost of the 7 waste heat boilers with the steel framework of the settings erected. These boilers are class M No. 26 Stirling waste heat boilers, for 180 lb. pressure. They have 7,460 sq. ft. of total heating surface and occupy each a space of 16 ft. by 20 ft. 4 in. by 26 ft. 4 $\frac{3}{4}$ in. The waste heat from the flue, common to all the reverberatories, enters the front of the boilers at the top. (See Fig. 87.)

Account 8309.01—Waste Heat Boilers—Brickwork.

This account covers all red and fire brick and tile with mortar and lumber for scaffolds, as well as mason and carpenter labor entering into the bricking of the waste heat boilers. The unloading of the brick and handling from the pile to the boiler site are taken care of elsewhere. (See Fig. 87.)

Account 8309.02—Waste Heat Boilers—Unloading Brick.

This covers the cost of preparing the site, unloading and checking all brick used under this account.

Account 8309.03—Waste Heat Boilers—Painting.

When the boiler settings were warm, they were given one coat of mineral red in oil. This account covers the labor and material incident to this operation.

Account 8309.05—Waste Heat Boilers—Rehandling Brick.

This covers the cost of handling brick a distance of 250 ft. from piles to site of waste heat boilers in wheelbarrows.

Account 8309.10—Oil-fired Boilers, Including all Steel.

Same as account 8309. (See Fig. 88.)

Boilers were 3, Class M, No. 14 Stirling for oil firing, having each 4.017 sq. ft. of heating surface. Each boiler occupied a space of 10 ft. by 20 ft. 4 in. by 26 ft. 4 $\frac{3}{4}$ in. The oil burners are not here included, but 3 stacks are of 48-in. diameter each and 60 ft. high above damper frame, made of No. 10 and No. 8 steel. (See Fig. 88.)

Account 8309.11—Oil-fired Boilers—Brickwork.

Same as account 8309.01. (See Fig. 88.)

Account 8309.12—Oil-fired Boilers—Unloading Brick.

Same as 8309.02.

Account 8309.13—Oil-fired Boilers—Painting.

Same as 8309.03.

Account 8309.15—Oil-fired Boilers—Rehandling Brick.

Same as 8309.05, save distance was about 300 ft.

Account 8310—Superheaters—Waste Heat Boilers.

This account covers the cost of the material and the labor of installing 7 Foster superheaters for class M, No. 26 waste heat Stirling boilers.

| | |
|----------------------------|------------|
| 7 Foster superheaters..... | \$8,256.40 |
| Miscellaneous..... | 32.31 |
| | <hr/> |
| | \$8,288.71 |

(See Fig. 88.)

Account 8310.10—Superheaters—Oil-fired Boilers.

This account covers the cost of the material and the labor of installing 3 Foster superheaters for class M, No. 14 oil-fired boilers.

| | |
|----------------------------|------------|
| 3 Foster superheaters..... | \$2,675.03 |
| Miscellaneous..... | 81.38 |
| | <hr/> |
| | \$2,756.41 |

Account 8312—Miscellaneous Piping. Boilers and Reverb. Building.

This account covers the cost of material and installation of miscellaneous piping in the boiler and reverberatory buildings. The sizes are various. It is not valuable for unit costs.

Account 8312.1—Excavation.

This account covers excavation and backfill for a long deep trench. The material met with was red clay filled with boulders and sand and gravel. It was done with picks and shovels, and handled 300 ft. with wheelbarrows and slips. Two hundred feet of the trench were cribbed and lagged 20 ft. high. Much of the dirt had to be handled three times in removing it from the trench.

Account 8312.11—Feed Piping from Heating Plant to Feed Pumps.

This account covers the cost of the pipe, pipe conduit, insulating material and the labor incident to installing them in a trench running from the hot water heating plant to the boiler feed pump house back of the boilers. The conduit was ordinary vitrified 15-in. sewer pipe split in halves. The first half was laid in the trench, the joints cemented, followed by the laying of the 8-in. standard wrought iron pipe. About this the asbestos filler was packed and after each section of the conduit top was laid, the filler was stuffed in over the top of the 8-in. pipe to thoroughly cover it. The material account is segregated as follows:

| | |
|---|------------|
| 557 ft. 15-in. J. M. sectional conduit..... | \$2,273.47 |
| 577 ft. 8-in. wrought-iron pipe..... | 374.49 |
| Asbestos filler and miscellaneous..... | 109.83 |
| | <hr/> |
| | \$2,757.79 |

Account 8312.20—Feed Piping from Pumps to Boilers.

This cost is not valuable for unit purposes. It represents pipe fittings, pipe covering, paint, and the labor of erecting pipe and fittings, covering some of the pipe with insulation, and painting all pipe. The piping was about one steam and two electrical feed pumps at the boilers. It also covers a hot water line the length of the boiler building, a cold water line the same length with connections from each line to each boiler. The two main lines are 6 in. The connections to the boilers are 3 in. The hot water lines are covered throughout. The pipes are of standard strength and the fittings are extra heavy. The labor costs include also the manufacture of all pipe hangers. A further segregation of the material is as follows:

| | |
|--------------------------------|------------|
| Pipe..... | \$416.39 |
| Fittings..... | 2,408.89 |
| Pipe covering..... | 137.26 |
| Hangers and miscellaneous..... | 78.46 |
| | <hr/> |
| | \$3,041.00 |

Account 8312.5—Blow-off Piping and Drum.

This cost is not valuable for unit purposes. It represents the cost of the material below and the labor of installing it. The blow-off piping runs about 10 ft. beyond the end of the boiler building and discharges there into a steel drum 4 ft. diameter by 4 ft. high, with an 8-in. diameter pipe riser. From the base of the drum it discharges into a sewer pipe nearby. The drum foundation is included in the concrete cost. A segregated material cost is as follows:

| | | |
|---|-------|----------|
| 225 ft. 2½-in. standard wrought-iron pipe | } | \$447.93 |
| 25 ft. 8-in. standard wrought-iron pipe | | |
| 20 ft. 2½-in. extra heavy non-rising stem gate valves | | |
| 20 ft. 2½-in. asbestos packed cocks | | |
| 1 blow-off drum, 4 ft. diam. by 4 ft. high } | ..... | 79.84 |
| | | <hr/> |
| | | \$527.77 |

Account 8313—Wiring Electrical Feed Pumps.

This covers the wiring of the two 40-h.p. motors of the feed pumps to the mains. The material was as follows:

| | |
|--------------------------------|---------|
| 2 circuit breakers | \$31.70 |
| Conduit and covering | 85.20 |
| Wiring and miscellaneous | 60.99 |
| <hr/> | |
| \$177.89 | |

Account 8313.1—Lighting for Reverb. and Boiler Building.

This represents the material and labor of hanging 104 drop lights in the boiler and reverberatory building.

| | | |
|---------------------------|---|----------|
| 8 tungsten lamps, 40 watt | } | \$473.19 |
| 96 carbon lamps, 16 c.p. | | |
| 145 ft. brewery cord | | |
| 2,710 ft. 1-in. conduit | | |
| Wire, switches, etc. | | |

Account 8314—Slag Launderers.

All the material cost and labor installation of these reverberatory slag launderers and two converter slag launderers are here included. The reverberatory slag launderers at the slag end of the furnace consist of a settler and spout. The settler is about 6 ft. by 3 ft. by 2 ft., made of ¾-in. steel plate and 3-in. by 3-in. angles. The spout leading from the settler to the slag cars is of cast iron 6 ft. 6 in. long and 1 in. thick. The converter slag launderers are built of cast iron about 1½-in. thick on the average, in 4-ft. 6-in. sections and are 24 ft. 6 in. long. They are set up aloft in the converter building on a structural steel frame made of 10-in. 15-lb. I's 2½ by 2½ by ¼ angles attached to the framework of the building, and lead into the top of the reverberatory furnaces.

Account 8315—Matte Launderers.

These launderers lead from small settler boxes at the tap holes of the reverberatories along the dirt floors in which they are set to a height of 10 to 12 ft. above the converter building floor where they discharge into properly located matte pots. The small boxes are of ¾-in. plate with 3 by 3 and 2½-in. by 2½-in. angles. The launderers are of cast iron average 2½-in. in thickness. Here is included the cost of the above material together with the labor of installing them.

Account 8316—Six No. 14 Wilgus Oil Systems.

This account covers the cost of 6 Wilgus oil pumps, asbestos covering for portions of these pumps, the labor of installing the pumps, the labor of thoroughly overhauling them, required because of the unsatisfactory condition existing in the leaking steam heating coils and the labor of applying the asbestos covering. The 5¼-in. by 3½-in. by 5-in. duplex oil pumps were set directly on the concrete floor in front of the oil-fired boilers.

Account 8317—Two Electrical Feed Pumps.

These pumps located back of the boilers were lowered into the 13-ft. pit onto their foundations and set ready for piping connections. They are two vertical triplex, 8-in. by 10-in. Aldrich, electrical driven pumps each attached with flexible couplings to a 40-h.p. motor. The cost covers the material segregated below and the labor of installing the same:

| | Factory | Freight | Clifton |
|---------------------------------|------------|----------|------------------|
| Two 40-h.p. motors..... | \$1,700.00 | \$24.44 | \$1,724.44 |
| Two vertical triplex pumps..... | 2,794.00 | } 547.07 | 3,859.07 |
| Spare parts for pumps..... | 518.00 | | |
| Miscellaneous..... | | | 50.46 |
| | | | <hr/> \$5,633.97 |

Account 8317.1—One Steam Feed Pump.

Here is given the labor of installing and the material cost of one 10-in. by 6-in. by 12-in. duplex boiler steam feed pump. This pump is located next to the two electrically driven Aldrich pumps of 8317.

Account 8317.2—Crawls and Chain Blocks in Feed Pump House.

This gives the cost of delivering and hanging in place in the feed water pump house two 2-ton steel plate crawls for lower flange of 8-in. I-beam, one 2-ton duplex chain block for 16-ft. lift together with the material cost as segregated below.

| | |
|----------------------------|----------------|
| Two 2-ton crawls..... | \$53.74 |
| One 2-ton chain block..... | 58.31 |
| | <hr/> \$112.05 |

Account 8318—Fettling System.

Here is given the cost of installing fettling tracks and cars over the three reverberatories. A structural steel frame to support an 18-in. gauge car and walkway was erected along each side of each reverberatory, being attached to the steel frame of the building. The cost of this material as given below and the labor of installing the same are here covered:

| | |
|---|------------|
| Three 18-in. gauge bottom dump cars with Hyatt roller bearings..... | \$196.83 |
| 3 steel turn plates $\frac{1}{2}$ in. by 72 in. by 138 in..... | 93.24 |
| 18.25 tons fabricated structural steel and rail..... | 1,492.66 |
| 2 by 12 lumber for walkways..... | 18.48 |
| Power for riveting and miscellaneous..... | 141.87 |
| | <hr/> |
| | \$1,943.08 |

Converter Plant

Account 8401—Excavation.

This was a large slice, similar to side hill work, through red clay and boulders into sand and gravel tightened with caliche. It was shaken up with powder, plowed, fresnoed through a trap into narrow-gauge side dump cars and conveyed 1,000 to 2,000 ft. by a narrow-gauge locomotive.

Account 8402—Foundation.

This was a big wall same as under 8301, with about 30 piers 5 ft. by 6 ft. by 8 ft. deep. The concrete was machine mixed, 7 parts sand and gravel to 1 cement, transported 75 ft. in concrete buggies and wheelbarrows. About 50 per cent. of the vertical surfaces was formed. Each pier had four 2-in. anchor bolts 6 ft. long.

Account 8403—Converter Building—Steel Structure.

(See account 7308.2). There is in this building 94.01 tons of corrugated iron and 689.85 tons of structural steel.

Account 8404—Converter Stands—Excavation.

This excavation was small rectangular cuts in sand and gravel, made with picks and shovels and handled in wagons 900 ft.

Account 8404.1—Converter Stands—Foundation.

This concrete was the same mix as 8402, but 100 per cent. of its vertical surfaces was formed. It was hauled 300 ft. to place in dump wagon and cars.

Account 8405—Converter Stands and Shells.

This account covers the cost of the material noted below, together with the labor required to install the stands, put together the parts of the converters, erect motors, controllers, solenoid brakes and attach blast connections. The unloading of this material from the cars is in account 8411. The shells were 12 ft. in diameter, of the Great Falls type, having each 28 tuyères of $1\frac{1}{2}$ in. diameter, extra heavy pipe.

| | |
|---|------------|
| Three cast-iron converter stands, with 50-h.p. motors, brakes, controller, etc..... | \$9,801.01 |
| Four 12-ft. converter shells..... | 12,115.46 |
| Blast connections, valves, etc..... | 321.81 |
| | <hr/> |

\$22,238.28

(See Figs. 126 and 127.)

Account 8405.01—Repairs to No. 2 Stand.

When No. 2 converter shell was let into place by the crane, it was allowed to fall a short distance and cracked the cast-iron stand. The stand was then taken off its foundation and patched with a steel plate.

Account 8405.10—Converter Shells—Brick Lining.

This account covers both the labor and material incident to lining four converter shells and tops with magnesite brick. In bottom of each shell there is an average of 9 in. of silicate of soda and burnt magnesite beneath the brick. Around the sides there are 4½ in. of this material laid in behind the brick. The top is laid with brick only. The material required for one converter is as follows:

28 sacks (286 lb. each) of magnesite cement.

50 sacks (234 lb. each) of burnt magnesite.

5 bbl. (635 lb. each) of silicate of soda.

4,385 magnesite brick of various shapes.

Account 8405.11—Converter Shells—Unloading Brick.

This covers the cost of the shed together with the checking, unloading and piling all magnesite brick, cement, magnesia and sodium silicate.

Account 8406—Cranes.

This covers the cost of two 40-ton Morgan cranes and the labor of installing them on the craneway, and putting together the equipment ready for operation. It does not include the wiring. They were hoisted place on the craneway by the use of two erecting engines. These cranes are of 40-ton capacity, have four motors, span 55 ft. from rail to rail, and are rigged for a 50-ft. lift. Each crane has a 15-ton auxiliary hoist. (See Fig. 90.)

Account 8406.1—Wiring Cranes.

This cost is not valuable as it represents 30 per cent. more labor than should have been spent. The cranes were wired twice because the first time was done improperly. The wiring is largely in conduits. Here too is the cost for the trolley lines from which the cranes take their power.

Account 8407—Clinkering Machines.

These two machines are set 24 ft. above the floor of the converter building on structural steel supports. The steel supports are a part of the converter building and have been costed in that account. The main body of the machine, the mixer, is the frustrum of a cone 13 ft. 6 in. long, whose head end is 5 ft. diameter and whose discharge end is 9 ft. 6 in. diameter. It is made of ¾-in. steel plate, lined with 1-in. cast-iron liners. The whole is mounted on trunnions operated by a 50-h.p. motor. The ladle which feeds the converter slag into the head

end is 60 cu. ft. capacity and is tilted by a screw operated by a 15-h.p. motor.

The feeder which lets siliceous ore into the head end to agglomerate with the slag extends from the silica bins to a pipe discharging into the dropping stream of slag. It is a screw conveyor 4 ft. 9 $\frac{1}{4}$ in. long. Each machine has a hood connected to a steel flue 2 ft. 6 in. diameter by 36 ft. 8 in. long, leading into the converter dust chamber.

| | |
|--|-------------|
| The machinery for two machines enumerated above cost | \$11,872.82 |
| Two 50-h.p. motors as above..... | 828.61 |
| Two 15-h.p. motors as above..... | 820.16 |
| 2 brakes for ladle tipping motor..... | 176.51 |
| 2 traveling switches for brakes..... | 136.44 |
| 2 circuit breakers..... | 102.80 |
| Miscellaneous..... | 44.60 |
| | <hr/> |
| | \$13,981.94 |

This cost includes the price of the machines and the cost of installing them.

Account 8407.01 Clinkering Machines—Alteration No. 1.

The teeth on the drive gears had to be chipped off and trued up so as to mesh properly.

Account 8407.02—Clinkering Machines—Alteration No. 2.

Account 8407.03—Clinkering Machines—Electrical Alterations.

Account 8407.1—Wiring Clinkering Machines.

This covers the labor and material of wiring the two 50-h.p. motors and two 15-h.p. motors operating the clinkering machines.

Account 8409—Wiring for Converter Control.

Account 8409.1—Lighting.

This covers the labor of installing the material incident to lighting the converter building, as well as the material itself. There were used thirty-four 16-c.p. carbon lamps, twenty-six 250 watt tungstens, 440 ft. of No. 8 and No. 12 weatherproof wire exposed, 880 ft. of No. 12 wire in $\frac{3}{4}$ -in. conduit, 684 ft. of No. 12 wire in 1-in. conduit.

Account 8410—Air Pipe from Power House—Excavation.

This covers the cost of digging a trench through sand, gravel and big boulders for a 24-in. pipe, with pick and shovel and backfilling the same.

Account 8410.1—Air Pipe from Power House—Laying.

This covers the cost of the material segregated below and the labor of installing it. The pipe was placed underground and ran from the power house to connect with all of the converters. It was built to carry air

under 12 lb. pressure of No. 8 U. S. gauge plate riveted, tested for 25 lb. pressure and painted with asphaltum paint. It was made in 30-ft. sections and fastened together with forged steel flanges.

| | |
|--|------------|
| 400 ft. 24-in. pipe, 10 in. cast-iron nozzles, tees and ells.... | \$1,332.70 |
| 22 ft. 10-in. pipe and two 10-in. flanges..... | 27.54 |
| Two 24-in. cast-iron gate valves..... | 415.25 |
| Three 10-in. cast-iron gate valves..... | 138.55 |
| Miscellaneous..... | 127.85 |
| | <hr/> |
| | \$2,041.89 |

(See Fig. 89.)

Account 8411—Ladles, Boats, Bails, Tools, Etc.

This account covers the cost of the material segregated below, the labor of unloading it, the labor of unloading material in account 8405, and the cost of material and manufacture of several converter collar pullers, as well as alterations upon the slag ladles and scrap boats.

| | Factory | Freight | Total |
|--|----------|---------|------------|
| One 7-ft. by 7-ft. slag boat complete with chain..... | \$362.00 | \$38.00 | \$400.00 |
| 2 converter scrap boats 9 ft. by 2 ft. 3 ½ in. high by 2 ft. 5 in. wide..... | 512.60 | 28.02 | 540.62 |
| 3 cast-steel slag ladles..... | 745.90 | 283.04 | 1,028.94 |
| 2 cast-steel matte ladles (20 tons capacity)..... | 1,152.45 | | |
| 1 bail..... | 400.00 | 519.11 | 2,371.56 |
| 1 bail..... | 200.00 | | |
| 1 pattern..... | 100.00 | | |
| 4 chains and converter lifting devices..... | | | 340.63 |
| 1 cast-iron skull breaker..... | | | 124.99 |
| Miscellaneous material for collar, etc..... | | | 125.65 |
| | | | <hr/> |
| | | | \$4,932.39 |

Account 8413—Casting Machines—Excavation.

This covers 2 deep rectangular cuts in sand, gravel and big boulders with pick and shovels. It was loaded into carts and hauled 600 ft.

Account 8414—Casting Machine—Foundation.

The foundation for each machine consisted of a rectangular sump with plain concrete floor enclosed by reinforced concrete retaining walls. The walls were about 6 in. thick, 8 ft. high, reinforced with ½-in. and ¾-in. rods. The concrete was machine mixed, 5 parts sand and gravel to 1 cement, hauled in cars 150 ft. dumped and handled to site in wheelbarrows 150 ft. 100 per cent. of the vertical concrete surfaces was formed.

Account 8415—Casting Machine—Cost and Erection.

This account covers the cost of all the material composing 2 casting

machines, and all the labor required to erect on their foundations ready to operate. Each machine has a steel cradle to receive a ladle of molten copper. This cradle is controlled from a pulpit and is tipped by the power from a 20-h.p. motor. It is set high enough to pour into a casting spoon of 1½-in. cast iron whose approximate dimensions are 2 ft. wide by 3 ft. 6½-in. long, and from 7 in. to 1 ft. 5½-in. deep. This casting spoon pours into the moulds which are attached to a heavy steel conveyor. The moulds are 39 in number, made of 2½-in. cast iron reinforced with ⅝-in. perforated plate. Their inside dimensions are 2 ft. 4 in. by 1 ft. 6¼-in. by 3¼-in. deep. From the pulpit, by use of power from a 20-h.p. motor, the conveyor with the moulds moves along under a spray of water from needle holes in pipes placed above them until they reach the end of the conveyor where a device in the bottom of the moulds loosens the ingots, allowing them to drop into a tank of water. This bosh is made of ⅝-in. plate, 3 by 3 and 4 by 3 angles. It is 7 ft. wide, 23 ft. 5¼-in. long, and varies in depth from 7 ft. 10 in. to 2 ft. 10 in. The copper bars are removed from here by a steel drag conveyor operated by a 11-h.p. motor, controlled from the pulpit. When the bars leave the bosh and fall onto the striking plate they are handled by a radial crane whose moving end travels on a 40-ft. curved I-beam. Along the radial crane beam travels a small air hoist capable of picking up 1 ton. It operates under an air pressure of 16 lb. A jib crane is so located, attached to a building column, that it can handle the moulds for removing and replacing. It has a 3,000 lb. capacity triplex block and 8-in. I-beam trolley. Below is a segregated material list:

| | |
|--|-------------|
| 2 casting machines..... | \$18,657.89 |
| Two 11-h.p. and four 20-h.p. motors..... | 2,933.88 |
| 2 jib cranes..... | 327.22 |
| 2 radial cranes..... | 1,167.91 |
| 2 traveling switches..... | 135.75 |
| 2 brakes for ladle tipping motors..... | 176.51 |
| 4 circuit breakers..... | 103.50 |
| Moulds, etc..... | 708.55 |
| | <hr/> |
| | \$24,211.21 |

(See Figs. 128 and 129.)

Account 8415.1—Casting Machine—Repairs.

Account 8416—Loading Platform—Excavation.

Same as 8413, except that it was not hauled away.

Account 8416.1—Loading Platform—Foundation.

This was a low retaining wall of gravity section 300 ft. long, machine mixed, 7 sand and gravel to 1 cement, transported in cars 150 ft. by wagon 350 ft. and by wheelbarrow 70 ft. One hundred per cent. of its vertical surface was formed.

Account 8416.11—Loading Platform—Floor.

This was a plain concrete floor mixed and handled as above, with a $\frac{1}{2}$ -in. finish of 2 sand to 1 cement. There were no joints in the concrete. The finish was troweled smooth.

Account 8416.2—Loading Platform—Backfill.

Behind the 300-ft. wall—8416.1 sand and gravel was backfilled. The material lay 8 to 10 ft. from the wall.

Account 8416.3 Loading Platform—Striking Plates.

Two striking plates, one at each casting machine are placed so that the copper ingots discharged from the casting machine elevator fall directly upon them. They were made by setting 4 by 4 by $4\frac{1}{2}$ -in. wood blocks dipped in hot tar and placed on end upon a concrete base. Over the blocks a steel plate 6 ft. $\frac{1}{2}$ in. by 9 ft. 10 in. by $\frac{1}{2}$ in. was laid and secured by 16 $\frac{3}{4}$ by $2\frac{1}{2}$ -in. bolts, grasped by cast-iron fasteners set in concrete below.

| | |
|---------------------------------------|----------|
| 283 ft. b.m. lumber..... | \$8.59 |
| 2 steel plates..... | 99.19 |
| 32 cast-iron fasteners and bolts..... | 18.91 |
| | <hr/> |
| | \$126.69 |

Account 8417—Hoods and Smoke Boxes.

This account covers all the material of the converter hoods, smoke boxes, flues leading to converter dust chamber, together with the labor of erecting them. It likewise includes removing the stacks 4 ft. in diameter, making new ones 5 ft. in diameter and erecting them together with change required to put large doors in the back of the boxes. The smoke boxes, of which there are three, are made of $\frac{3}{8}$ -in. plate, and 4 by 4 by $\frac{3}{4}$ angles. They are 16 ft. high and about 9 ft. in diameter. The hoods, of which there are three, are made from $\frac{1}{2}$ -in. plate and 4 by 4 by $\frac{3}{8}$ angles. They hang on the front of the smoke boxes and direct the gases into the flues. The original stacks, of which there were three connecting the smoke boxes and the converter dust chamber, were 4 ft. diameter and 26 ft. long, made of $\frac{3}{8}$ -in. plate. They were replaced by similar ones 5 ft. in diameter. (See Fig. 92.)

Account 8417.1—Hood to Protect Converter Operator.

Only one of these was made. Three-sixteenth inch plate was used. The dimensions are 7 ft. 2 in. by 7 ft. 2 in. by 7 ft. 8 in. high, one end is open. The account covers material used, fabrication and erection.

Account 8418—Spouts, Gates and Hoppers at Silica Ore Bins.

This account covers the material cost of the gates with operating devices, the 10-in. pipe chutes and the labor of erecting same, together

with the labor of erecting the hoppers. The hoppers were furnished by the Kansas City Structural Steel Co., and are costed with the building. The hoppers are situated below the silica bins, above the converters and by a spring device and pointer indicate to an operator on the ground when they have been filled to the desired amount. The gates allow the material to flow through a 10 in. pipe chute directly into each converter. These chutes can be turned aside from the converter mouth by a chain, wheel and gear so as not to interfere when out of use. (See Fig. 93.)

Account 8419.1—10-ton Bullion Scales—Excavation.

The excavation consisted of small cuts made in sand and gravel with pick and shovel and cast to one side.

Account 8419.2—10-ton Bullion Scales—Foundations.

This concrete was cast plain in low 8-in. thick walls about a pit 4 ft. by 6 ft. in plan. The mix was machine made, 6 sand and gravel to 1 cement, and transported a distance of 1,900 ft. in wagons. Seventy-five per cent. of the walls' vertical surface was formed.

Account 8419.3—10-ton Bullion Scales—Cost and Erection.

This represents the cost of the scales and the labor of installing them. The scales were pit pattern, 10-ton copper bullion class, with type registering beam weighing to 1 lb. They came complete with all necessary structural steel framework and cast-iron platform plate.

Account 8419.4—10-ton Bullion Scales—Scale House.

This is a shed roof building without sides about 16 ft. by 20 ft. The roof is of 1-in. sheathing, covered with composition roofing. It was painted 2 coats of oil and lead.

Account 8425—Conveyor No. 15.

(See account 7405.)

Conveyor No. 15 is a 20-in. belt, making a conveyor 165 ft. long, running perfectly flat, operating at a speed of 300 ft. per minute, capable of handling 100 tons per hour. It receives material from conveyor 14 and delivers it to the silica bins of the conveyor building through an automatic tripper. The account is segregated as follows:

| | |
|--|----------|
| Belt..... | \$664.19 |
| Robins Material..... | 1,231.91 |
| Centrifugal switch..... | 36.20 |
| Lumber (decking, etc.)..... | 67.05 |
| Spout from No. 14 to No. 15..... | 31.21 |
| 29 ft. 6 in. of 5-in. d.l. drive belt..... | 20.82 |
| 7½-h.p. motor | 138.75 |
| Miscellaneous..... | 61.34 |

\$2,251.47

(See Fig. 91.)

Account 8426.1—Wet Pan—Excavation.**Account 8426.2—Wet Pan—Foundation.**

This concrete was hand mixed. Owing to some conditions not satisfactorily ascertained the concrete did not set. This necessitated its being put in twice. The yardage is that of one installation and the cost two. The mix is 7 to 1.

Account 8426.3—Wet Pan—Cost and Erection.

This mill was installed to furnish "mud" for the converters and reverberatories. The account covers the material segregated below and the labor of installing the same.

| | |
|--|------------|
| One 5-ft. wet pan; size of mullers 36 in. by 4½-in.; pulley 34 in. by 10-in.; 4-arm type friction clutch | \$634.34 |
| One 15-h.p. motor, 860 r.p.m. squirrel-cage with starting compensator..... | 248.45 |
| One 18 by 10 solid hub cast-iron pulley..... | 15.47 |
| One 38 by 7 solid hub cast-iron pulley..... | 24.71 |
| Two 2 1/8 by 24-in. drop hangers..... | 23.48 |
| 11 ft. by 2 in. 2 1/8 shafting, collars, etc..... | 13.10 |
| 30 ft. 6-in. double leather belting..... | 25.39 |
| 35 ft. 9-in. double leather belting..... | 44.42 |
| Miscellaneous..... | 20.74 |
| | <hr/> |
| | \$1,050.10 |

Account 8426.4—Wet Pan—Bins and Spout.

This bin with spout was made in the smelter shops, using ¼-in. steel plate. It has a capacity of 260 cu. ft. The account covers the material used, labor of fabrication and erection.

Converter Dust Chamber**Account 8421—Excavation.**

This account covers the making with pick and shovel of small cut for a retaining wall, and digging a number of small pier holes. The material was red clay and stones, running into sand and gravel which was loaded into carts and hauled 600 ft.

Account 8422—Foundation.

This concrete was cast as piers about 4 ft. by 4 ft. by 5 ft. about 45 per cent. of whose vertical surface was formed. It was mixed in a machine, in the proportions of 7 sand and gravel to 1 cement, transported by cars and wheelbarrows 200 ft. The pier tops were finished to a perfect elevation to receive structural steel columns.

Account 8423—Steel Structure.

(See account 7308.2.) This structure contained 228.18 tons of structural steel and 10.12 tons of Keystone plate roofing. (See Fig. 94.)

Account 8423.01—Wire Baffles.

(See account 8132.01, for description.) This account covers the cost of the material below and the labor incident to its erection.

| | |
|---|------------|
| 14,365 lb. No. 10 steel wire baffles..... | \$670.34 |
| 8,500 lb. $\frac{3}{8}$ -in. steel chains, 2-in. links..... | 430.91 |
| Miscellaneous..... | 0.70 |
| | <hr/> |
| | \$1,101.95 |

(See Figs. 94 and 95)

Account 8423.1—Tile Work.

This is identical with 8123.1.

Account 8423.11—Unloading Tile.

This is identical with 8123.11.

Account 8424—Iron Doors and Frames.

This covers the cost of the cast-iron doors, etc., set in the tile work of the converter dust chamber. The labor represents hauling the same to the site. The labor of setting is included with the tile work.

5 cast-iron peep doors and frames, doors 4 ft. 6 in. by 2 ft. 6 in..... \$158.93

Account 8428—Smoke Box Track.

This is a track back of the smoke boxes for the converters. The material is second hand, picked up from construction equipment. The account is of no value.

Conveying System**Account 8501—Excavation.**

This covers excavation made at various times for piers and trenches for walls to support the conveying system structures. The ground was mostly red clay and boulders, sometimes sand and gravel. The excavating was done with pick and shovel and the material cast to the side of the cuts.

Account 8502—Foundation.

This account covers plain concrete cast in a great many piers, and reinforced concrete cast in a shape to make two long tunnels through which conveyors 11 and 14 rise from below conveyors 10¹ and 10² located under the bunker bins. The tunnels are 6 ft. by 6 ft. with 12-in. walls, reinforced with $\frac{1}{2}$ -in. and $\frac{3}{4}$ -in. rods, spaced 6 in. About 80 per cent. of the vertical surfaces was formed. All concrete was machine mixed in different proportions and transported variously to the many different situations.

Account 8503—Steel Structure.

(See account 7308.2.) There were here used 30.94 tons of corrugated iron, and 180.79 tons of structural steel. These structures are elevated steel conveyor ways.

Account 8504—Woodwork.

This account represents the labor and material of flooring the steel conveyor ways for conveyors 3, 4, 5, 6, 11 and 14. The lumber used was 2 by 12 S1S2E No. 1 merchantable Oregon pine. On No. 14 the 2 by 12's were rabbeted. Considerable cutting was done to frame about conveyor steel framesupports. This cost includes also attaching nailing strips to the steel work to which the flooring was nailed. (See Fig. 96.)

Account 8504.1—Floor Battens.

This account covers labor and material incident to nailing battens beneath the floor boards of conveyors 3, 4, 5, 6 and 11. The lumber here used was not rabbeted.

Account 8505—Conveyors No. 3, 4, 5, 6, 11 and 14.

(See account 7405.) Conveyor No. 3 has a 20-in. belt, making a conveyor 182 ft. 5½ in. long, rising 46 ft., operating at a speed of 250 ft. per minute, with a capacity of 150 tons per hour. It conveys concentrates from No. 2 belt into the sampling mill.

Conveyor No. 4 has a 20-in. belt, making a conveyor 220 ft. 9 in. long, rising 64 ft., operating at a speed of 250 ft. per minute, having a capacity of 100 tons per hour. It takes crushed ore from the crushing plant to the top of the sampling mill.

Conveyor No. 5 has a 20-in. belt, making a conveyor 127 ft. long, having a rise of 26 ft. 4 in., operating at a speed of 250 ft. per minute, with a capacity of 150 tons per hour. It carries the fines from the sample mill on their way to the beds.

Conveyor No. 6 has a 20-in. belt, making a conveyor 113 ft. 8 in. long, having a rise of 25 ft. 6 in., operating at a speed of 250 ft. per minute with a capacity of 100 tons of ore per hour. It carries material from the sample mill on its way to the bunker bins.

Conveyor No. 11 has a 20-in. belt, making a conveyor 369 ft. 8½ in. long, having an 87-ft. rise, operating at a speed of 300 ft. per minute with a capacity of 100 tons per hour. It conveys the product from conveyor 10¹ to conveyor 12 at the Roasters.

Conveyor No. 14 has a 20-in. belt, making a conveyor 271 ft. 5 in. long, having a 71-ft. rise, operating at a speed of 300 ft. per minute with a capacity of 100 tons per hour. It takes ore from conveyor 10² beneath the bins to conveyor 15.

The material for these conveyors somewhat segregated is as follows:

| | Factory | Freight | Clifton |
|---|------------|----------|-------------------|
| Belt..... | \$5,351.03 | \$365.88 | \$5,716.91 |
| Robins material..... | 4,290.86 | 530.49 | 4,821.35 |
| Extra pulley..... | | | 38.00 |
| 4 centrifugal switches..... | 136.00 | 8.81 | 144.81 |
| One 10, one 15, and four 20-h.p. motors | | | 1,309.68 |
| 5 overload releases..... | 65.00 | 6.25 | 71.25 |
| Miscellaneous, decking, etc..... | | | 403.62 |
| | | | <hr/> \$12,505.62 |

Account 8505.1—Chutes.

This cost is of no value.

Account 8505.2—Guides.

The belts in the conveying system could not be made to run true on the troughing idlers. To overcome their riding out of position long boards were fixed at the sides of the belts to guide and keep them in position. These boards were picked up about the plant and the cost represents only the labor of installing them.

Account 8505.3—Weightometer.

This account covers the cost and labor of installing a Merrick weightometer on conveyor 11. The weightometer is installed on a 20-in. inclined conveyor belt with a speed of 300 ft. per minute, whose angle of inclination is 13 degrees 28 minutes and whose troughing idlers are 4 ft. on center lines. The belt has a normal capacity of 100 tons per hour.

Account 8506—Lighting.

This represents installing the following lights:

33 drops
1,285 ft., No. 12 weatherproof wire
120 ft. of conduit

Chimney**Account 8601—Excavation.**

This was a deep hexagonal cut made through clay, caliche and well into sand and gravel containing big boulders. The material was loosened with picks, slipped out with fresnos, dumped through a trap into carts and hauled 2,700 ft.

Account 8602—Foundation.

This was a very large block of concrete cast in a hexagonal shape 20 ft. deep and 50 ft. inside least diameter. In the bottom of the block 3 layers of 1-in. rods laid 1 ft. on centers were placed. The mixture was machine made, 8 parts sand and gravel to 1 cement, using lots

of large rock. About 40 per cent. of the vertical surface was formed. The concrete was transported in cars 100 ft.

Account 8603—Brickwork.

The stack was contracted erected by the Alphons Custodis Chimney Construction Co. It is 300 ft. high, 26 ft. 8 in. inside diameter at the base and 22 ft. at the top. The average thickness of the walls is about $24\frac{1}{2}$ in. Every 25 ft. inside the stack is corbelled out to hold the lining of radial perforated fire brick, laid in acid-proof mortar. The base of the stack is of red brick and the round portion is of perforated radial blocks. The outside upper 75 ft. of the stack were pointed with acid-proof mortar. There was used in the construction:

| | |
|-------------------------|----------------------------|
| 138,000 lb. lime | 652 tons wire cut brick |
| 290 lb. cement | 56 tons wedge brick |
| 1,638 tons radial brick | 100 bbl. acid-proof mortar |

The cost here given includes constant inspection by the Arizona Copper Co. organization. (See Fig. 97.)

Reverberatory Flue

Account 8611—Excavation.

This covers the excavating of some long deep trenches for footings and a large amount of back filling. It was done in red clay and gravel with picks and shovels. The back filling was wheeled 25 ft. to place and tamped in 5-in. layers.

Account 8612—Foundation.

This concrete was cast in 2 long reinforced concrete cantilever type retaining walls. The walls were 12 in. at the top, 14 in. at bottom, and 5 ft. high. One-half-inch and $\frac{3}{4}$ -in. rods, spaced 6 in. centers, were used. The mixture was machine mixed in the proportion of 5 sand and gravel to 1 cement, transported in wagons, wheelbarrows and concrete carts 250 ft. to place. Ninety-five per cent. of the vertical surface of the concrete was formed.

Account 8613—Brickwork.

This account is similar to others of the same nature, including cost of tile, mortar, scaffolds, and the labor of masons, their helpers, and carpenters. (See Figs. 98 and 100.)

Account 8613.01—Unloading Brick.

This covers the cost of preparing site, unloading tile, and the checking of same.

Account 8614—Steel Structure.

(See account 7308.2.) There were 32 tons of structural steel used here and 9.61 tons of Keystone plate roofing. (See Fig. 99.)

Account 8614.1—Clean Out Doors.

This covers the cost of labor of altering and material in the clean out doors and frames for this flue

| | |
|---|----------|
| 18 cast-iron frames and steel plate doors, $1\frac{3}{8}$ in. by $16\frac{1}{2}$ in. by 2 ft. $2\frac{1}{2}$ in | \$128.27 |
| $\frac{1}{2}$ -in. sheet steel and miscellaneous..... | 25.34 |
| | <hr/> |
| | \$153.61 |

Account 8614.2—Caulking Roof.

This account covers the labor and material of making as nearly air-tight as was possible the roof to this flue. Asbestos wicking was caulked into all the bad joints.

Converter Flue**Account 8621—Excavation.**

This was a small amount of excavation for a number of piers through red clay with boulders and sand and gravel. It was done with pick and shovel, the dirt being cast to the sides of the holes.

Account 8622—Foundation.

These foundations were 14 plain concrete piers about 4 ft. 6 in. by 4 ft. 6 in. by 5 ft. The concrete was machine mixed, about 7 parts sand and gravel to 1 cement, and transported 200 ft. in wheelbarrows and concrete carts to place. Seventy-five per cent. of the vertical surfaces was formed.

Account 8624—Steel Structure.

(See account 7308.2.) 81.99 tons of structural steel were used here. (See Fig. 101.)

Roaster Dust Chamber Flue**Account 8626—Excavation.**

This excavation covers the cuts for a number of piers through red clay containing boulders, made with pick and shovel and thrown to one side of the excavation.

Account 8627—Foundation.

This concrete was cast in 12 piers about 4 ft. 6 in. by 4 ft. 6 in. by 5 ft. It was plain concrete, machine mixed in proportions of 7 sand and gravel to 1 cement, and was transported to place 200 ft. in cement cars and wheelbarrows. Seventy-five per cent. of the vertical surface was formed.

Account 8628—Brickwork.

This is the same as 8123.10. (See Figs. 99, 100, 102, and 104.)

Account 8628.01—Unloading Tile.

This is the same as 8123.11.

Account 8629—Steel Structure.

There were 85.21 tons of structural steel used here and 9.25 tons of Keystone plate roofing. The flue is 6 ft. 6 in. by 12 ft. in cross section and connects the roaster dust chamber with the stacks. (See Fig. 102.)

Boiler and Blacksmith Shop**Account 8701—Excavation.**

This excavation involved making a 6-ft. slice to get the proper grade for the building site, together with piers and small wall excavation. It was plowed and slipped away in fresnos 400 ft.

Account 8702—Foundations.

These foundations were the small walls and piers for the brick and steel column supports. The concrete was plain, hand mixed in the proportions of 6 sand and gravel to 1 cement, and handled 100 ft. in wheelbarrows to the forms. Fifty per cent. of the vertical surface was formed. This was the first concrete cast at the smelter.

Account 8703—Steel Structure.

There were 32.72 tons of structural steel used in the framework of the building. (See Fig. 105.)

Account 8703.1—Doors, Windows and Frames.

This account covers the purchase price of all doors, windows, their frames, lintels and glass. It also covers the labor of installing the steel lintels which run from building column to building column; the erection of the steel door and window frames; the erection of the steel sash and doors; and the glazing of these doors and windows. After the lintels had been framed in, the tile work brought up to sill base and the sill set, the frames were put in place, bolted to the lintels and tied by rods back to the building columns. When the frames had been entirely bricked in, the steel sash were bolted in place and later glazed. A segregated material list is as follows:

Thirteen 11 ft. 7 in. by 12 ft. $\frac{7}{8}$ in. steel sash 63 lights, 2 mullions, with 3 to 6 light ventilators, not glazed.

One 10 ft. 3 in. by 12 ft. $\frac{7}{8}$ in. steel sash 56 lights, 1 mullion, no ventilators not glazed.

Two 10 ft. 3 in. by 12 ft. $\frac{7}{8}$ in. steel sash, 48 lights, 1 mullion, no ventilators, not glazed.

One 4 ft. by 9 ft. steel sliding door, with six 14 in. by 20 in. lights, not glazed, lower panels steel plate.

One 8 ft. by 9 ft. steel sliding door, with eighteen 14 in. by 20 in. lights, not glazed, lower panels steel plate.

One 14 ft. by 20 ft. Kinner steel rolling door.

One 10 ft. by 10 ft. Kinner steel rolling door.
 Eleven 14-ft. 10-in. lintels built up of 8-in. channels.
 Two 13-ft. 4-in. lintels built up of 8-in. channels.
 Two 11-ft. 6-in. lintels built up of 8-in. channels.
 One 10-ft. 4-in. lintels built up of 8-in. channels.
 One 11-ft. 6-in. lintels built up of 8-in. channels.
 850 lights 14 in. by 20 in., $\frac{1}{8}$ in. factory ribbed glass,
 164 lights 13 $\frac{1}{2}$ in. by 19 $\frac{1}{2}$ in. factory ribbed glass.
 82 lights 14 in. by 19 $\frac{1}{2}$ in. factory ribbed glass.
 44 lights 13 $\frac{1}{2}$ in. by 20 in. factory ribbed glass.
 Steel windows and door frames for above made of two 3 $\frac{1}{2}$ by 2 $\frac{1}{2}$ by $\frac{1}{4}$ angles.
 (See Fig. 106.)

Account 8703.11—Concrete Sills.

This account covers the labor and material used to make the following list of concrete sills. The sills were made 3 parts sand and gravel to 1 cement, cast in collapsible moulds and later finished. Three $\frac{5}{8}$ -in. rods are used in each sill.

11 sills, 8 $\frac{1}{2}$ in. by 10 in., 14 ft. 10 in. long.
 1 sill, 8 $\frac{1}{2}$ in. by 10 in., 11 ft. 6 in. long.
 1 sill, 8 $\frac{1}{2}$ in. by 10 in., 8 ft. 6 in. long.
 2 sills, 8 $\frac{1}{2}$ in. by 10 in., 12 ft. 2 in. long.

(See Fig. 21.)

Account 8703.2—Tile Walls.

This cost includes the cost of tile, mortar and scaffolds, together with the mason and carpenter labor used to build the walls. The walls were non-bearing 8 in. thick, built of hollow tile, laid in between the steel building columns. The mortar used was 1 cement, 1 lime and 1 sand.

Account 8703.21—Unloading Tile.

This covers the cost of preparing site, unloading, and checking quantity of tile.

Account 8703.22—Coping.

This covers the cost of labor and material incident to coping the walls at the top, beneath the roof. A two by four was bolted to the top course of tile and another to the underside of the roof. These were lathed across with metal lath and plastered with cement mortar. (See Fig. 17.)

Account 8703.30—Roof.

This account covers the cost of the material and labor incident to roofing the boiler and blacksmith shop. Oregon pine sheathing, 2 by 8, surfaced, tongued and grooved, was nailed to strips bolted to the purlins. Over this 3-ply asbestos roofing paper was laid. (See Fig. 17.)

Account 8703.31—Ventilators.

This covers the cost of labor and material incident to installing three 48-in. Burt ventilators on the peak of the boiler and blacksmith shop roof.

The ventilators were skidded up onto the roof with hand tackle along a runway, bolted to the purlins and flashed. (See Fig. 18.)

Account 8703.4—Dirt Floor.

This account covers the labor incident to bringing the dirt floor of this building to the required grade. The dirt was wheeled in and tamped in 3-in. layers.

Account 8703.5—Benches.

This account covers the labor and material of making from time to time benches, racks and the like used in this shop.

Account 8703.6—Painting.

This covers the cost of painting all the steel sash one coat of "turkey red." and the woodwork, namely, the under side of the roof two coats of white lead and linseed oil, cream color.

Account 8704—Crane.

This covers the purchase of the crane listed below, the labor of overhauling and erecting it.

| | |
|--|----------|
| One 3-ton hand power traveling crane, chain block transfer type 18-ft. span, complete with roller bushed geared trolley and provided with 3-ton triplex chain block for 13 ft. lift..... | \$378.35 |
| Miscellaneous..... | 60.06 |
| | <hr/> |
| | \$438.41 |

Account 8705—Tools.

This account covers the purchase price of the tools enumerated below and the labor required to install them.

| | Factory | Freight | Clifton |
|--|------------|----------|------------|
| 1 No. 2 punch and shear, Hilles & Jones..... | \$1,530.00 | \$435.00 | \$1,965.00 |
| 1 No. 0 bending rolls..... | 580.00 | 75.00 | 655.00 |
| One 1,100-lb. steam hammer, Niles-Bement-Pond Co. | | | |
| 1 blower, size 5, type D, American Blower Co.... | 1,015.00 | 408.00 | 1,423.00 |
| One 5-h.p. 440-volt, 3-phase, 60-cycle 1,720-r.p.m. motor..... | 160.00 | 19.90 | 179.90 |
| 1 No. 5 swage block..... | | | 35.08 |
| 1 Peter Wright anvil, weight 497 lb..... | | | 70.57 |
| 10 in. galv. iron pipe and connections..... | | | 106.63 |
| 3 sheets steel, $\frac{3}{8}$ in. by 48 in. by 120 in..... | | | 16.02 |
| One 2-in. heading, upsetting and forging machine, Acme Machinery Co..... | 2,790.00 | 440.70 | 3,230.70 |
| 1 sisco anvil, 407 lb..... | | | 46.60 |
| 1 Hay Budden anvil, 420 lb..... | | | 48.10 |
| 40 ft. of 6-in. I-beam..... | | | 12.62 |
| Castings..... | | | 41.00 |
| Miscellaneous..... | | | 29.14 |
| | | | <hr/> |
| | | | \$7,859.36 |

Account 8706—Shafting, Pulleys, Belting.

This account covers the purchase price of the list of material below and the labor of installing the same, and the necessary wooden bridge trees.

- 33 ft. of 2 $\frac{7}{8}$ -in. and 18 ft. of 2 $\frac{1}{2}$ -in. shafting.
- 5 pulleys, varying from 26 in. to 52 in. with bearings and hangers.
- 1 length of 8-in. double leather belt, 104 ft. long.
- 1 length of 6-in. double leather belt, 140 ft. long.

(See Fig.19.)

Account 8707—Motor.

This account covers the purchase price of the material below and the labor of installing it. This motor furnished the power for the boiler and blacksmith shops.

One 20-h.p. 440-volt, 3-phase, 60-cycle, 850-r.p.m. motor.

Account 8708—Lighting.

This account covers the cost of the material below and the labor of its installation.

- | | |
|--------------------------|----------------------|
| 14 carbon lamps, 16 c.p. | 260 ft. brewery cord |
| 3 tungstens, 250 watt | 300 ft. No. 12 wire |
| 100 ft. conduit. | |

Machine and Carpenter Shop**Account 8715—Excavation.**

Same as account 8701.

Account 8716—Foundation.

Same as account 8702.

Account 8717—Steel Structure.

This building is the same as 8703 account. There were used here 38.23 tons of structural steel. (See Fig. 105.)

Account 8717.1—Doors, Windows and Frames.

This account is the same as 8703.10, with the following list of material:

- Thirteen 11 ft. 7 in. by 12 ft. $\frac{7}{8}$ in. steel sash, 63 lights, 2 mullions, with 3 to 6 light ventilators, unglazed.
- Two 10 ft. 3 in. by 12 ft. $\frac{7}{8}$ in. steel sash, 56 lights, 1 mullion, no ventilators, unglazed.
- Two 10 ft. 3 in. by 12 ft. $\frac{7}{8}$ in. steel sash, 48 lights, 1 mullion, no ventilators, unglazed.
- Two 4 ft. by 9 ft. steel sliding doors, with six 14 in. by 20 in. lights, unglazed, lower panels steel.
- One 11 ft. by 12 ft. steel sliding door, with forty 14 in. by 20 in. lights, unglazed, lower panels steel.
- Two 14 ft. by 20 ft. Kinner steel rolling doors.

Fourteen 14-ft. 10-in. lintels, made of 8-in. channels.

Six 11-ft. 6-in. lintels, made of 8-in. channels.

Seven hundred forty 14 in. by 20 in., $\frac{1}{8}$ in. thick factory ribbed glass window panes.

One hundred sixty-four 13 $\frac{1}{2}$ in. by 19 $\frac{1}{2}$ in., $\frac{1}{8}$ in. thick factory ribbed glass window panes.

Eighty-two 14 in. by 19 $\frac{1}{2}$ in., $\frac{1}{8}$ in. thick factory ribbed glass window panes.

Twenty 15 in. by 20 in., $\frac{1}{8}$ in. thick factory ribbed glass window panes.

Steel window and door frames for the above list. (See Fig. 106.)

Account 8717.11—Concrete Sills.

Same as account 8703.11, but the following product:

Thirteen 8 $\frac{1}{2}$ in. by 10 in., 14 ft. long sills.

Two 8 $\frac{1}{2}$ in. by 10 in., 11 ft. 6 in. long sills.

Two 8 $\frac{1}{2}$ in. by 10 in., 6 ft. 6 in. long sills.

(See Fig. 21.)

Account 8717.20—Tile Walls.

Same as account 8703.20.

Account 8717.21—Unloading Tile.

Same as account 8703.21.

Account 8717.22—Wall Coping.

Same as account 8703.22.

Account 8717.30—Roof.

Same as account 8703.30. This roof contains 77.21 squares, equal to 14,543 b.m. 2 by 8 lumber.

Account 8717.31—Ventilators.

Same as account 8703.31. Three 48-in. Burt ventilators used here.

Account 8717.40—Floor.

This account covers the cost of the material and labor required to lay this floor. Six inch by eight inch stringers were laid 2 ft. 6 in. on centers with earth tamped in between them. On the stringers No. 3 grade, 3 in. by 12 in. white cedar planking of various lengths was spiked down. (See Fig. 24.)

Account 8717.50—Benches.

Same as account 8703.50.

Account 8717.60—Painting.

Same as account 8703.60.

Account 8718—Crane.

This is the same as account 8704, with the exception that the crane here used is of 5 ton capacity.

Account 8719—Tools.

This account covers the purchase price of all the material listed below and the labor cost of installing it:

| | Factory | Freight | Clifton |
|---|----------|---------|------------|
| 1 Prentiss machine bench vise, No. 2.. | ..... | ..... | \$20.15 |
| 1 machine bench vise, No. 21..... | ..... | ..... | 20.16 |
| 1 machine bench vise, No. 22..... | ..... | ..... | 28.85 |
| 1 machine pipe vise, No. 2A..... | ..... | ..... | 2.38 |
| 1 machine pipe vise, No. 4A..... | ..... | ..... | 7.77 |
| 1 stationary bench vise, No. 56..... | ..... | ..... | 20.72 |
| 40 ft. of 1½-in. pipe..... | ..... | ..... | 2.97 |
| 1 No. 48 power grindstone..... | ..... | ..... | 56.62 |
| 2 emery wheels..... | ..... | ..... | 8.90 |
| 1 emery wheel grinder..... | ..... | ..... | 17.00 |
| 1 No. 40 special turning machine..... | ..... | ..... | 36.22 |
| 1 set faces for wiring machine..... | ..... | ..... | 5.56 |
| 1 gauge..... | ..... | ..... | 2.35 |
| 1 burr machine and stand..... | ..... | ..... | 9.92 |
| 1 No. 17 S. P. crimper and stand..... | ..... | ..... | 10.77 |
| 1 No. 3 beading machine..... | ..... | ..... | 26.79 |
| 1 No. 0236 squaring shears..... | ..... | ..... | 180.86 |
| 1 stake-holder and stakes..... | ..... | ..... | 42.15 |
| 1 rivet set..... | ..... | ..... | 2.65 |
| 1 No. 101 tinner's rule..... | ..... | ..... | 2.73 |
| 1 power hack saw No. 3..... | ..... | ..... | 29.63 |
| 1 radial drill press, 42 in..... | ..... | ..... | 752.20 |
| Miscellaneous..... | ..... | ..... | 21.92 |
| 1 50-in. cornice brake..... | ..... | ..... | 155.96 |
| 1 16-in. rip saw..... | ..... | ..... | 4.30 |
| Castings..... | ..... | ..... | 10.10 |
| 1 No. 1 drill chuck..... | ..... | ..... | 5.61 |
| 1 No. 2½ drill chuck..... | ..... | ..... | 7.02 |
| 72 hack saw blades..... | ..... | ..... | 5.55 |
| 1 surfer, 20 in. by 6 in..... | \$180.00 | \$26.70 | 206.70 |
| 1 No. 50 hand saw..... | 175.00 | 27.45 | 202.45 |
| 1 lathe, 14 in. by 8 ft..... | 563.75 | 81.40 | 645.15 |
| 1 lathe, McCabe patented double spindle. | 2,111.00 | 277.15 | 2,388.15 |
| 1 Crescent saw table..... | 168.75 | 51.34 | 220.09 |
| One 20-in. Rockford shaper..... | 425.00 | 175.07 | 600.07 |
| One 2-in. bolt cutter..... | 355.00 | 47.10 | 402.10 |
| 1 Crane pipe machine 2 in..... | 192.00 | 16.56 | 208.56 |
| 1 Crane pipe machine 4 in..... | 480.00 | 44.10 | 524.10 |
| 1 Crane pipe machine 12 in..... | 1,500.00 | 163.59 | 1,663.59 |
| Small tools, miscellaneous equipment..... | ..... | ..... | 394.36 |
| | | | <hr/> |
| | | | \$8,953.13 |

Account 8720—Shafting, Pulleys and Belting.

This account covers the purchase price of the material below and its cost of installation:

- 1 pc. 30 ft., 2 $\frac{1}{8}$ in. diameter shafting.
- 1 pc. 60 ft., 2 $\frac{1}{8}$ in. diameter shafting.
- 1 pc. 18 ft., 2 $\frac{1}{8}$ in. diameter shafting.
- 1 pc. 18 ft., 2 $\frac{1}{16}$ in. diameter shafting.
- 1 pc. 22 ft., 2 $\frac{1}{16}$ in. diameter shafting.
- 1 pc. 10 ft., 2 $\frac{1}{16}$ in. diameter shafting.
- 1 pc. 4 ft., 2 $\frac{1}{16}$ in. diameter shafting.

Many pulleys ranging from 10 in. to 68 in. diameter, with necessary hangers, collars, boxes, etc. (See Fig. 19.)

Account 8721—Motor.

This account covers the purchase price and cost of installing the following motor.

One 40-h.p., 440-volt, 3-phase, 60-cycle, 850-r.p.m. motor.

(See Fig. 20.)

Account 8722—Lighting.

This covers the cost of the following material and the labor of installing it.

| | |
|-----------------------------------|----------|
| 17 carbon lamps | 16 c.p. |
| 3 tungstens | 250 watt |
| 240 ft. brewery cord | |
| 100 ft. conduit | |
| 360 ft. No. 12 weatherproof wire. | |

(See Fig. 23.)

General Office

Account 8804—Furniture and Fixtures.

This account covers the furniture and fixtures purchased for the smelter office, which to date has not been built. The furniture is in use in the temporary offices.

Warehouse

Account 8810—Excavation.

This was the same as 8701.

Account 8811—Foundation.

This was the same as 8702, save that the walls were higher.

Account 8812—Steel Structure.

This building is the same type as the boiler and machine shops, save a corrugated iron roof was used in place of a wood and paper covering. There were 26.5 tons of structural steel used and 13.26 tons of corrugated iron. (See Fig. 26.)

Account 8812.1—Doors, Windows and Frames.

The doors for the warehouse were similar to the boiler and machine shops. The lintels over the windows and doors were the same as in

the shops. The small doors, all windows and frames were wood. This account covers the cost of the door and window material listed below and the labor of installing the same.

| | |
|---|------------|
| 51 windows, 3 ft. 9 $\frac{7}{8}$ in. by 7 ft. 8 $\frac{1}{2}$ in. by 1 $\frac{1}{8}$ in. These were grouped 16 in triple frames, all glazed..... | \$305.99 |
| 16 wood frames for 48 of above windows | 170.32 |
| Lumber for 3 window frames, all door frames and all hardware.... | 83.78 |
| 1 O. G. 1 light glazed door, 3 ft. 6 in. by 7 ft. 1 $\frac{3}{8}$ in..... | 7.91 |
| Two 9 ft. 10 in. by 7 ft. 6 $\frac{1}{2}$ in. Kinner rolling doors | 157.30 |
| Steel lintels..... | 331.01 |
| (See Fig. 27.) | |
| | <hr/> |
| | \$1,056.31 |

Account 8812.11—Concrete Sills.

See account 8703.11. Sills were made here for frames of account 8812.10. (See Fig. 22.)

Account 8812.2—Tile Walls.

Same as for account 8703.11.

Account 8812.21—Unloading Tile.

Same as for account 8703.21. (See Fig. 26.)

Account 8812.22—Coping.

Same as for account 8703.22. (See Fig. 28.)

Account 8812.3—Painting Roof.

This covers the labor and material of painting underside of corrugated iron roof 2 coats of lead and linseed oil, cream color.

Account 8812.31—Ventilators.

Same as for account 8703.31. These three ventilators were 48 in. diameter with round base. (See Fig. 25.)

Account 8812.40—Floor Excavation.

This entailed cutting down the front in the warehouse 6 to 8 in. and backfilling in places.

Account 8812.41—Floor Concrete.

This concrete floor was cast in large 6 ft. to 8 ft. blocks, 4 in. thick, with sand joints between blocks. The concrete was hand mixed in the proportions of 6 sand and gravel to 1 cement. It was transported in wheelbarrows 100 ft. The top finish, $\frac{3}{4}$ in. thick, was 2 sand to 1 cement. This top was troweled smooth.

Account 8812.50—Lighting.

This account covers the cost of the following material and the labor of installation.

26 carbon lamps, 16 c.p. 365 ft. brewery cord
170 ft. No. 12 weatherproof wire.

Account 8813—Fixtures.

This account covers the purchase price of the steel bins, shelving, counter scales, office partition and furniture, as listed below; also the erection cost.

| | |
|---|------------|
| 197 ft. Bergers sectional steel bins and shelving. See sketch, lineal feet refers to half of bins shown by sectional elevation. Bins received knocked down, gauge of material 16 to 20..... | \$1,116.82 |
| 1 No. 1046 dormant warehouse scales, weighing 5,000 lb. to $\frac{1}{2}$ lb..... | 141.42 |
| Furniture, material for office partition, etc. | 282.88 |

(See Fig. 30.)

\$1,541.12

Account 8813.10—Painting.

This account covers the cost of material and labor of a lot of miscellaneous painting at the warehouse. The steel doors were given one coat of turkey red. The iron lintels were given one coat of lamp black in linseed oil. The counter was stained and oiled.

Account 8813.11—Painting Sash.

This account covers the cost of material and labor used to paint all the warehouse sash. They were given two coats of white lead and linseed oil, cream color.

Laboratory**Account 8820—Excavation.**

This covers the excavating for the laboratory walls and basement in red clay with boulders and gravel. It was done with pick and shovel, and wheeled 75 ft. in barrows. Some backfilling for the floors in 3-in. layers is also here included.

Account 8821—Foundation.

This covers the concrete building walls which were machine mixed, in the proportions 8 sand and gravel to 1 cement. The concrete was handled in wagons 250 yd. The walls were 12 in. at top to 18 in. at bottom. One hundred per cent. of the vertical surface was formed.

Account 8821.1—Plain Concrete Floors.

These floors were mixed, 5 sand and gravel to 1 cement, in a machine, transported 1,000 ft. in wagon and laid 4 in. thick with a smooth finish. Sand joints were used. The top finish was $\frac{1}{4}$ in. thick, 2 parts sand to cement, and was troweled smooth.

Account 8821.2—Reinforced Floors.

These floors were formed, two way reinforced with $\frac{1}{2}$ -in. and $\frac{3}{4}$ -in. rods. In other respects they were the same as 8812.1.

Account 8821.3—Sills and Lintels.

The sills and lintels used at the laboratory were separately moulded reinforced concrete. The concrete was made 3 parts sand and gravel to 1 cement. Three $\frac{5}{8}$ -in. rods ran the entire length of both sills and lintels. The lintels were 8 in. by 8 in. by 5 ft. The sills were $4\frac{1}{2}$ in. by 9 in. by 4 ft. 1 in. (See Fig. 34.)

Account 8822—Tile Walls.

This account covers the tile, mortar, scaffolds, mason labor, carpenter labor, and hauling incident to building the tile walls of the laboratory.

Account 8822.2—Carpenter Work.

This account covers the material and carpenter labor incident to the installation of the partitions, ceilings, and roof structure. (See Fig. 31.)

Account 8822.5—Doors, Windows and Frames.

This account covers the cost of the following material and the labor of installing the same, together with the necessary frames.

- 16 windows 6 ft. 8 in. by 3 ft. $1\frac{1}{8}$ in. by $1\frac{3}{8}$ in. glazed.
- 5 sash with four, 12 in. by 24 in. lights, glazed.
- 1 sky light 6 ft. $31\frac{1}{8}$ in. by 6 ft. $9\frac{3}{4}$ in. with 36, 12 in. by 14 in. double strength glass
- 1 sky light 6 ft. $31\frac{1}{8}$ in. by 4 ft. $6\frac{1}{2}$ in. with 24, 12 in. by 14 in. double strength glass.
- 1 sky light 4 ft. $1\frac{7}{8}$ in. by 4 ft. $6\frac{1}{2}$ in. with sixteen 12 in. by 14 in. double strength glass.
- 4 doors 2 ft. 8 in. by 6 ft. 8 in. by $1\frac{3}{4}$ in., glazed.
- 4 doors 2 ft. 8 in. by 6 ft. 8 in. by $1\frac{1}{2}$ in. glazed.

(See Figs. 32 and 33.)

Account 8824—Wood Fixtures.

The account covers the cost of the laboratory hoods, stacks, benches, cabinets and the like.

Account 8825—Lighting.

This account covers the wiring in the laboratory for lights, hot plates, furnaces, etc.

Account 8826—Plumbing.

This account covers the purchase price of the material below and the labor of installing it.

| | |
|------------------------------|------------------------|
| 1 flush closet | 1 distilling apparatus |
| 2 sinks and drains | 1 water tap |
| Piping, fittings, lead, etc. | |

Account 8828 - Painting.

This covers the cost of the material and labor incident to painting at the laboratory. It is of no value for unit costs.

Account 8829 Plastering.

This covers the cost of plastering material, scaffolds plasterers and carpenter labor used in plastering the inside tile walls of the laboratory. The plastering was contracted at 18 cents a square yard, while the company furnished all material and carpenter labor.

Account 8830 Apparatus.

This account covers the purchase price of the material segregated below, and the labor of setting up the same.

| | |
|--|----------|
| Five 12 in. by 18 in. by 6 in. 110-volt hot plates | \$143.08 |
| 1 Thompsons analytical balance style 28 | 91.65 |
| 1 distilling apparatus | 62.70 |
| 1 Hoskins electric furnace | 225.53 |
| 1 electric drying oven | 41.79 |
| Brushes, tubing, funnels, etc | 54.23 |
| | <hr/> |
| | \$618.98 |

Account 8831 -Oil Centrifuge.

This apparatus was located near the oil tanks in a corrugated iron shed, 4 ft. by 4 ft. by 8 ft. The labor in this account was for the building as well as setting up the centrifuge and delivering the material.

| | |
|--|----------|
| 1 Braun oil centrifuge, vertical, direct compound type, 110 volt, alternating. | \$139.25 |
| Material for shed. | 18.34 |
| | <hr/> |
| | \$157.59 |

Sample Room**Account 8841 Excavation.**

This excavation covered the making of a thin top slice and shaping the ground for a plain concrete floor. The dirt was red clay. It was done with pick and shovel and cast to one side.

Account 8842 - Foundation.

This covers the making of a few small concrete walls, machine mixed, 8 sand and gravel to 1 cement. Seventy five per cent. of the vertical surface was formed. The concrete was handled about 150 ft.

Account 8842.1 Concrete Floors.

These floors were of smooth troweled concrete, 5 in. thick, machine mixed, 5 sand and gravel to 1 cement, the top finish 1 in. thick, 2 sand and 1 cement. All of the material was hauled in wagons 500 ft. The concrete was laid in blocks with sand joints.

Account 8843—Walls and Roof Structure.

This account covers the purchase price of the following material and the cost of erection.

| | |
|--|----------|
| Lumber for sides and roof rafters..... | \$148.12 |
| Corrugated iron..... | 47.68 |
| Nails, etc..... | 6.01 |
| | <hr/> |
| | \$201.81 |

(See Fig. 35.)

Account 8843.4—Roof.

This account covers the roof sheathing, composition paper, and the labor incident to installing it.

| | |
|--|---------|
| 1,008 b.f., 1 in. by 12 Oregon pine..... | \$31.50 |
| 10 squares 3-ply asbestos roofing..... | 45.07 |
| | <hr/> |
| | \$76.57 |

Account 8843.5—Doors and Windows.

This account covers the cost of the following material, and the cost of installing the same:

| | | |
|--|---|----------|
| Two 3 ft. by 7 ft. by 1 $\frac{3}{8}$ in. doors..... | } | \$115.24 |
| Twelve 2 ft. 11 $\frac{1}{4}$ in. by 5 ft. 3 $\frac{3}{8}$ in. by 1 $\frac{3}{8}$ in. windows, glazed .. | | |
| Frames for doors and windows..... | | |
| Miscellaneous..... | | 3.61 |
| | | <hr/> |
| | | \$118.85 |

Account 8844—Oven.

This account covers the making of a drying oven, together with the cost of material and installation. The oven was made in the shops of $\frac{3}{16}$ -in. sheet plate, 4 ft. by 2 ft. by 6 ft. high, and lined with $\frac{3}{16}$ -in. asbestos mill board. It had suitable shelves of pipe coils.

| | |
|------------------------|---------|
| One oven..... | \$46.77 |
| Steam piping, etc..... | 11.79 |
| | <hr/> |
| | \$58.56 |

Account 8845—Motor Platforms and Fixtures.

This covered the cost of the following material and its installation:

| | |
|---|----------|
| 4 bucking boards, 3 ft. diameter by 2 $\frac{1}{4}$ in. thick | \$61.80 |
| 21 sheets galvanized iron (No. 18) for pans, etc | 53.06 |
| Lumber for one bench top, 3 ft. by 12 ft. for pulverizers, and one bench top 2 ft. by 12 ft. for cutting samples..... | 14.74 |
| | <hr/> |
| | \$129.60 |

Account 8846—Lighting.

This covers the cost of the lighting wiring for seven lights.

Account 8848—Painting.

This covers the cost of material and labor incident to painting the sash of this building, two coats of white lead and linseed oil.

Account 8849—Machinery.

This covers the purchase price of the list of material given below, together with the labor of installing it.

| | Factory | Freight | Clifton |
|--|----------|---------|----------|
| Two 2 by 6 roll jaw crushers. (Sturtevant Milling Co.)..... | \$250 00 | \$51.80 | \$301.80 |
| 4 jaw plates..... | 10 00 | 0.80 | 10.80 |
| 4 shields..... | 3 00 | 0 22 | 3.22 |
| 8 toggles..... | 3 00 | 0 14 | 3.14 |
| 4 toggle seats..... | 4 00 | 0 11 | 4.11 |
| 2 Jones samplers 10 by 18 in. | 10 00 | 2 25 | 12.25 |
| 4 Braun pulverizers, 9 in. pul. | | | 363.48 |
| 2 Braun coal grinders, light and loose pulleys, 12 in. diameter. | | | 147.62 |
| Moisture scales..... | | | 20.11 |
| Sieves and miscellaneous | | | 15.47 |
| | | | \$912.00 |

Account 8849.1 Motor.

This covers the purchase price and cost of installing the following motor.

| | |
|-------------------------------|----------|
| One 5-h.p. Westinghouse motor | \$116.77 |
|-------------------------------|----------|

Account 8849.2 Shafting, Pulleys and Belting.

This account covers the cost of the material segregated below and the labor of installing it:

| | |
|---|----------|
| One 24 in. by 6 in. by 1½ in. bore wood split pulley | |
| Four 26 in. by 6 in. by 1½ in. bore wood split pulley | |
| Two 22 in. by 2 in. Princeton clutch pulley | |
| 26 ft. 1 in. of 1½ in. shafting | \$138.13 |
| 4 rigid ring oiling pillow blocks | |
| Two 1½ in. safety set collars | |
| Leather belting for motor 2 in., 3 in. and 5 in. | 32.04 |
| | \$170.17 |

MISCELLANEOUS ACCOUNTS**Account 8901—Derricks and Construction Equipment.**

This account is indirect expense, see 8999. The charge covers the cost of all derricks, concrete mixers, carts, wagons, picks, shovels, in fact every tool used during construction.

Account 8902—Sewer System—Cost of Pipe and Laying.

This account covers the cost of the material and labor of laying the same used in the sewer system. The sewer lines aggregated 2,967 ft. of vitrified sewer pipe, ranging from 6 in. to 15 in. in diameter. It was all laid an average depth of 4 ft. below the surface. Concrete manholes for the system are in account 8902.2.

Account 8902.1—Sewer System—Excavation.

This excavation covers the entire trenching or tunneling as was in some cases done for the sewer system. All kinds of soil were run through. The trenches varied from 18 in. to 60 in. wide, and from 2 ft. to 20 ft. in depth.

Account 8902.2—Sewer System—Concrete.

This concrete covered a large number of small jobs including manholes and the like along the sewer lines. In general the mix was 7 sand and gravel to 1 cement.

Account 8903—Permanent Outside Closets.

This covers 3 latrines built of 2 by 4's, 4 by 4's and corrugated iron. In size they were 8 ft. by 19 ft. 6 in. by 8 ft. high. The closet was built of concrete and is cleaned by a periodical flushing of water which is siphoned into a sewer.

Account 8904—Telephone System.

This account is indirect expense, see 8999. It covers the cost of a telephone line from Clifton to the smelter, together with all phones and connections about the plant during construction.

Account 8905—Permanent Outside Lighting.

The material account here is as follows:

| | |
|---------------------------------------|----------|
| Four 110 volt flaming arc lamps | \$142.40 |
| Conduit, wire, etc. | 35.59 |
| | <hr/> |
| | \$177.99 |

The poles here used were old ones previously charged out to construction equipment. The lights were placed at various needed points about the plant and then connected to the nearest 110-volt circuit. Labor costs cover the setting of poles, the connecting of lamps, running a conduit line down each pole to a switch box, and installing the switch box.

Account 8905.1—Temporary Outside Lighting.

This account is indirect expense, see 8999.

Account 8906—Water Pipe Lines—Excavation.

This excavation covers the trenching for all the water lines. It represents all sorts of material excavated from 8 ft. to 15 ft. in depth.

Account 8906.01 Water Pipe Lines Concrete.

This was a small amount of concrete used to anchor the 6-in. line at the foot of the hill, as it comes down from the tank.

Account 8906.02 Water Pipe Lines Cost and Laying.

This account covers the cost of the material and labor of laying all the water lines about the smelter.

There was 2,052 ft. of 6-in. pipe
 1,058 ft. of 4-in. pipe
 200 ft. of 2½-in. pipe
 268 ft. of 2-in. pipe
 115 ft. of 1½-in. pipe
 50 ft. of 1-in. pipe
 4,253 ft.

Total of 4,253 ft. with all necessary fittings, valves, and fire hydrants.

Account 8906.1 Six-Inch Pipe Line from Clifton.

This account covers the cost of the material and labor incident to laying a 6-in. water pipe line, 8,988 ft. long, from Clifton to smelter. It includes excavating, painting, and backfill.

Account 8906.2 Water Supply Tank Excavation.

This covers the making of a 3 ft. slice for a water tank foundation. It involved the use of powder, and was handled with picks, shovels, and wheelbarrows.

Account 8906.4 Water Supply Tank Cost and Erection.

This tank was erected on a hill at an elevation of 200 ft. above the tracks where the material was received. It is 40 ft. in diameter, 26 ft. 9½ in. high, and has a steel cover. Its capacity is 250,000 gallons. The tank steel was erected by contract. The account stands thus:

| | |
|------------------------------------|----------|
| Road work | \$72 80 |
| Hauling | 121 31 |
| 33.67 tons, tank erected | 3,550 00 |
| Freight on tank | 235 69 |
| Power for riveting | 92 31 |
| Miscellaneous | 64 92 |

\$4,137 03

Account 8907—Watchman.

This account is indirect expense, see 8999. It covers the pay of watchman during the construction period.

Account 8908—Power Distribution.

This account covers the cost of material and labor incident to the following work. Two- and three-inch conduits were run underground

from the power house to the heater house and to the converter building. Along these lines four concrete manholes or pull boxes were installed. At the converter building the wire from the conduits run up a steel column and from thence on steel brackets through the reverberatory and boiler building to a point of distribution by poles. From this point the wires go to the roasters, sample mill, crushing plant, and bedding plant. The wire ranged from 1,000,000 c.m. to No. 12 weatherproof.

Account 8908.1—Temporary Oil Tanks.

This account is indirect expense, see 8999. It covers the cost and erection of an oil tank with pipe lines used during the construction period.

Account 8909—Permanent Air Line—Excavation.

This covers the cost of trenching and backfilling for the air lines. The trenches were in every kind of soil, 18 in. to 6 ft. deep and 1 ft. to 3 ft. wide.

Account 8909.1—Permanent Air Line—Laying.

This account covers the cost of material used and the labor of installing the same. The lines together are 2,316 ft. long and composed of the following quantities of different sized pipe.

| | |
|---------------------|---------------------|
| 526 ft., 1-in. pipe | 656 ft., 2-in. pipe |
| 36 ft., 1½-in. pipe | 838 ft., 3-in. pipe |
| 80 ft., 1½-in. pipe | 180 ft., 4-in. pipe |

Account 8910—Transmission of Power to Various Departments.

This is a suspense account which has been charged away.

Account 8911—Watchman House.

This account is indirect expense, see 8999. It covers the cost of a temporary building.

Account 8912—Tool Shed.

This account is indirect expense, see 8999. It covers the cost of a temporary building.

Account 8913—Barn and Corral.

This account is indirect expense, see 8999. It covers the cost of the corral and barn.

Account 8914—Temporary Blacksmith Shop.

This account is indirect expense, see 8999. This is a temporary building used during construction.

Account 8916—Temporary Power Plant.

This account is indirect expense, see 8999. It covers a large compressor, Maune type boiler and temporary building, together with the labor of installation.

Account 8917—Temporary Crushing Plant.

This account is indirect expense, see 8999. It covers the cost and installation of a 10-in. by 20-in. crusher, 65-ft. bucket, elevator, rock and sand bins, shafting, belts, pulleys and motors.

Account 8918—Temporary Water Tanks.

This account is indirect expense, see account 8999. It covers several small tanks erected for use at the temporary camp site, as well as a large general supply, wooden tank.

Account 8919—Temporary Electrical Shop Equipment.

This account is indirect expense, see 8999. It covers a temporary shop equipment.

Account 8920—Wagon Roads.

This account is indirect expense. It covers the building of many roads and trails required during the construction period.

Account 8921—Temporary Pumping Plant.

This account is indirect expense. It covers a timbered shaft, pump and pipe line.

Account 8922—Temporary Pipe Lines.

This account is indirect expense. It covers the cost of all temporary water and air lines laid during the construction period.

Account 8923—Temporary Warehouse.

This account is indirect expense. It covers the cost of the temporary warehouse and equipment.

Account 8924—Temporary Cement Sheds.

This account is indirect expense, see 8999. It covers the cost of corrugated iron sheds for storing cement.

Account 8925—Horses, Harness and Carts.

This is indirect expense, see 8999. This covers the cost of some carts, work harness, and the purchase price of an animal killed during construction.

Account 8926—Temporary Office.

This account is indirect expense, see 8999. This covers the cost of the construction office.

Account 8927—Temporary Lavatories.

This account is indirect expense, see 8999.

Account 8928—Temporary Machine Shop.

This account is indirect expense, see 8999. This covers the cost of temporary machine shop.

Account 8929—Employee's Railroad Transportation.

This account is indirect expense, see 8999. During the construction period 300 to 500 men were employed, over three-fourths of whom lived in and around Clifton. The cost of transporting these men back and forth each day was borne by the construction.

Account 8930—Clearing Land.

This account is indirect expense, see account 8999.

Account 8931—Test Holes.

This account is indirect expense, see 8999.

Account 8933—Furniture and Fixtures.

This account is indirect expense, see 8999. It covers the temporary office fixtures.

Account 8934—Miscellaneous Supplies.

This account is indirect expense, see 8999.

Account 8935—Shop Equipment.

This account is indirect expense, see 8999. It covers material used in various temporary shops.

Account 8936—Overhead Shop Expense.

This account is indirect expense, see 8999. This account covered all labor and supplies used in the shops not directly charged to the work in hand.

Account 8937—Stock Lumber.

This is a suspense account.

Account 8938—Powder Magazine.

This account is indirect expense, see 8999.

Account 8939—Miscellaneous Labor.

This is indirect expense, see 8999.

Account 8941—Temporary Railway Receiving Bins.

This account is indirect expense, see 8999.

Account 8942—Water Supply.

This account is indirect expense, see 8999. It covers the cost of water from Clifton used during construction.

Account 8943—Corral Expense.

This was suspense account distributed at the close of each month, on the basis of the cost per animal-day.

Account 8944—Switching and Freight from Clifton.

This account is indirect expense, see 8999. It was impossible to place these charges to the material freighted, owing to incomplete records.

Account 8945—Office Stationery and Supplies.

This account is indirect expense, see 8999.

Account 8946—Warehouse Operating Expense.

This account is indirect expense, see 8999. It covers the expense of running the warehouse during the construction period.

Account 8927—Timekeeping Expense.

This account is indirect expense, see 8999. It covers the expense of the timekeeping and distribution during the construction period.

Account 8948—Form Lumber.

This is a suspense account. Its money was apportioned to all concrete costs on the basis of board-feet of lumber used on each job.

Account 8949—Cement.

This was a suspense account. It was apportioned to all concrete accounts on the basis of sacks used.

Account 8951—Sand and Gravel.

This is a suspense account. Its money was apportioned to the different concrete accounts on the basis of cubic yards of concrete cast.

Account 8952—Employee's Quarters.

This account is indirect expense, see 8999. It represents the cost of a boarding house, bath house, and 42 tent houses, less the rent they paid on during the construction period.

Account 8953—Crushing Plant Operating Expense.

This is a suspense account. Its money was apportioned to the different concrete jobs on the basis of cubic yards of concrete benefiting.

Account 8954—Concrete Power and Repairs.

This is a suspense account, see 8953.

Account 8955—Mortar Sand.

This is a suspense account. It was apportioned to the brick-work on the basis of the amount used by the various jobs.

Account 8955.1—Mortar Lime.

This is a suspense account, see 8953.

Account 8955.2—Mortar Cement.

This is a suspense account, see 8955.

Account 8955.4—Fire Brick Mortar.

This is a suspense account, see 8955.

Account 8955.5—Silica Brick Mortar.

This is a suspense account, see 8955.

Account 8956—Operating Temporary Power House.

This is a suspense account. It was apportioned to the various jobs on the basis of horse power days.

Account 8957—Maintenance of Track in Yards.

This account is indirect expense, see 8999. It represents the upkeep of tracks during construction, and the cost of many temporary construction tracks.

Account 8958—Ditch at Tunnel No. 2.

This account is indirect expense, see 8999. It represents a ditch built by the Arizona & New Mexico Railway, to protect their main line which has been endangered by surface water as a result of the site chosen for the smelter.

Account 8961—Steam Heating System—Excavation.

This covers the making of a long shallow trench and backfilling it. The ground was red clay.

Account 8961.1—Steam Heating System—Cost and Installation.

This covers the cost of laying 260 ft. of 2-in. steam pipe and 236 ft. of 2½-in. steam pipe in a 2-in. lumber box. The pipe was covered with double standard magnesia covering.

Account 8975—Cleaning Up.

This account is an indirect charge, see 8999. It represents cleaning up about the plant after construction.

Account 8976—Rehandling Brick and Tile.

This account is an indirect charge, see 8999. It represents handling tile not directly chargeable to the jobs where the tile was used, but as a result of other considerations.

Account 8998—Direct Charges.

This account is indirect expense, see 8999. It represents direct charges to indirect expense.

Account 8999—Indirect Expense.

This account is a summation of the accounts, as listed under charges to indirect expense. As the total of indirect expense, they represent a percentage of the total cost of the smelter, less the engineering and indirect expenses, and have been so reported. In the making of any total estimate based on the unit costs derived from this sheet, it is assumed that of the total estimate, 7.53 per cent. will be taken to ascertain the item of indirect expense.

POWER PLANT

Power House

Account 9001—Excavation.

This excavation was a large cut, about 55 ft. by 280 ft. by 10 ft., for the basement of the power house, the machine foundation and the building piers. The material encountered was red clay and boulders on top, with sand and gravel beneath which was saved for concrete material. Powder was used, followed by plowing, picks, shovels, fresnos, and carts. The material was hauled 450 ft. (See Fig. 53.)

Account 9002—Building Foundation Piers.

This concrete was cast in piers which supported the steel columns. The piers were about 3 ft. by 4 ft. by 3 ft. plain concrete, hand mixed, in the proportions of 7 sand and gravel to 1 cement, and transported 150 ft. in wheelbarrows to place. A great deal of difficulty was experienced here in keeping out the sand and gravel which constantly *sluffed* in from the sides. Fifty per cent. of the vertical surface was formed.

Account 9002.1—Building Foundation Walls.

This concrete was cast as a long reinforced wall running around outside and bearing on the columns of the building. It is 12 in. at top, 20 in. at bottom, 11 ft. high, designed as a slab to withstand earth pressure on a 20-ft. span. The concrete was machine mixed in the proportions of 5 sand and gravel to 1 cement, wheeled 150 ft. to place and reinforced with $\frac{3}{8}$ - and $\frac{1}{2}$ -in. rods variously spaced. Ninety-five per cent. of the vertical surface was formed. (See Fig. 47.)

Account 9002.2—North Tunnel.

This concrete was cast as a box culvert in an open cut. It is about 6 ft. by 7 ft. by 300 ft. long. It was hand mixed in the proportions of 5 sand and gravel to 1 cement, wheeled 100 ft. to place and reinforced with $\frac{1}{4}$ in. and $\frac{1}{2}$ -in. rods. Fifty-five per cent. of the vertical surface was formed, as well as the roof of the culvert. (See Fig. 50.)

Account 9002.3—Concrete Drain.

This concrete forms a drain through the middle of the power-house basement. There are two walls, 10 in. thick, 18 in. high, 3 ft. apart, with a 9-in. bottom in the drain laid on grade. The concrete was one-half machine and one-half hand mixed, in the proportions of 7 sand and gravel to 1 cement, wheeled in barrows 150 ft. to place. Ninety per cent. of the vertical surface was formed.

Account 9002.4—Basement Floor—Concrete.

This concrete was cast as a floor on grade in the basement of the power house. It was laid in 6-ft. blocks with sand joints. The mixture,

machine made, was 7 parts sand and gravel to 1 cement. The top finish was $\frac{3}{4}$ in. thick and made 2 parts sand to 1 cement. The total thickness of the floor is 4 in. The concrete was transported in barrows on an average of 125 ft.

Account 9002.45—Basement Floor Painting.

This account covers material cost and labor of cleaning floor and applying two coats of Toch Brothers cement filler.

Account 9002.6—Preparing of Concrete for Painting.

This covers the cost of preparing basement concrete walls for painting. The air holes were filled, rough surfaces smoothed, and one coat of cement grout applied.

Account 9002.7—Painting Concrete.

This account covers the cost of the material and labor of applying it to the power house basement walls. One coat of Wadsworth Howland Bay State cement coating was put on. This cost \$1.88 a gallon f.o.b. Clifton. The material account is as follows:

| | |
|---------------------------|----------|
| 150 gallons of paint..... | \$281.40 |
| Brushes..... | 8.42 |
| Turpentine..... | 5.71 |
| Miscellaneous..... | 6.08 |
| | <hr/> |
| | \$301.61 |

Account 9003—Steel Structure.

This account covers all the structural steel including railings and the like used in the power house building. There were 254.29 tons. (See Fig. 54.)

Account 9003.1—Tile Walls.

This account covers the cost of all the tile, mortar material, scaffolds, mason labor, carpenter labor, and hoisting power required to lay up the walls. The walls were 40 ft. high on the average from the ground level. The walls were 8 in. thick, laid directly upon the concrete walls. See account 9002.1. Two mortars were used in laying up the tile, one with lamp black in to give the outside joint a pleasing appearance. The joints were struck. The mortar mixture was 1 cement, 3 sand, and 1 lime. (See Figs. 52 and 54.)

Account 9003.11—Unloading Tile.

This account covers the preparing of the site for unloading, checking quantities and unloading the tile used in the power plant.

Account 9003.12—Wall Coping.

Similar to account 8703.22, which see. The depth of this coping was, however, 18 in. against 12 in. at the warehouse and shops.

Account 9003.2—Doors, Windows and Frames.

This account covers the doors, sash, hardware and frames listed below, together with the labor cost of installing the same. The steel frames were made by the Kansas City Structural Steel Co.

| | Factory | Freight | Clifton |
|--|----------|---------|------------------|
| 105 single sash, 2 ft. 8 $\frac{1}{2}$ in. by 5 ft. 1 $\frac{1}{2}$ in. by 1 $\frac{1}{2}$ in. glazed with 15 ribbed glass lights, fixed sash..... | \$325.50 | ..... | ..... |
| 1 single sash, 2 ft. 8 $\frac{1}{2}$ in. by 4 ft. $\frac{1}{2}$ in. by 1 $\frac{1}{2}$ in. glazed with 12 ribbed glass lights, fixed sash..... | 26.00 | ..... | ..... |
| 73 windows, 2 ft. 8 $\frac{1}{2}$ in. by 6 ft. 3 in. by $\frac{1}{2}$ in. glazed with 18 ribbed glass lights, double hung..... | 284.70 | ..... | ..... |
| 40 sash, 3 ft. $\frac{1}{2}$ in. by 2 ft. 6 $\frac{1}{2}$ in. by 1 $\frac{1}{2}$ in. glazed with 6 ribbed glass lights, hinged. . . | 56.00 | | |
| | | \$93.05 | \$785.25 |
| Steel frames for all but the 40 6-light sash and 6 door frames, 3 ft. 1 in. by 7 ft. 6 in. . . | 1,815.20 | 292.77 | 2,107.97 |
| 300 Caldwell sash balances, No. 18. | | | 111.95 |
| 3,884 ft. b.m. lumber for frames for 40 single sash. | | | 91.44 |
| Locks, hinges, nails, etc. | | | 223.32 |
| | | | <hr/> \$3,319.93 |

(See Fig. 51.)

Account 9003.21 Concrete Sills.

This account covers the material used and the labor expended in making the power house concrete sills. About one-half of the sills were cast in place and the remainder as separately moulded members. They were 8 in. by 10 in. for the windows and 3 in. by 10 in. for the fixed sash at the top of the building. The material was hand mixed, 3 sand to 1 cement, and 3 $\frac{1}{2}$ -in. rods ran the length of the sills. (See Fig. 51.)

Account 9003.3—Ventilators.

This covers the cost of 6 48-in. Burt ventilators with square base and the labor of installing them on the roof of the power house. They were lifted onto the roof with a locomotive crane.

| | | | |
|------------------------------|----------|----------|----------------|
| 6 Burt ventilators | \$280.17 | \$152.57 | \$432.74 |
| Miscellaneous | | | 7.02 |
| | | | <hr/> \$439.76 |

Account 9003.4 Main Floor Columns.

This account covers the cost of the material, fabrication, and labor of erecting 57 pipe columns and 11 structural steel columns to support the steel beams of the power house floor. The 57 pipe columns were made of 4-in. pipe, with a cast iron base and capital, and were so placed

that they might be easily shifted a foot or two along the low flange of the I beams they support, should they interfere with future piping schemes. The structural columns were permanently located. The material segregated is as follows:

| | |
|----------------------------------|----------|
| Caps and bases, cast iron..... | \$227.80 |
| 668 ft. of 4-in. pipe..... | 186.40 |
| Structural steel and rivets..... | 136.99 |
| Miscellaneous..... | 75.25 |
| | <hr/> |
| | \$626.44 |

Account 9003.41—Main Floor Slab—Concrete.

This account covers the cost of the Berger multiplex plate laid on the steel I beams of the power-house floor, and covered with concrete reinforced with $\frac{1}{2}$ -in. and $\frac{1}{4}$ -in. rods. The Berger plate was laid upon steel beams and not wired; $\frac{1}{4}$ -in. and $\frac{1}{2}$ -in. rods, 1 ft. on concrete, were laid in the concrete at right angles with the grooves of the plate. The concrete mixture was 7 parts sand and gravel to 1 cement, machine made. The top finish was proportioned 2 sand to 1 cement. It was laid $\frac{3}{4}$ in. thick, smooth troweled, and marked off in 6-ft. squares. The material account stands thus:

| | |
|---|------------|
| 102.1 square, 3-in. Berger plate | \$2,101.88 |
| $\frac{1}{4}$ -in. and $\frac{1}{2}$ -in. reinforced steel..... | 62.06 |
| Concrete materials..... | 1,177.67 |
| | <hr/> |
| | \$3,341.61 |

(See Fig. 55.)

Account 9003.42—Painting under Side Main Floor.

The Berger plate exposed beneath the floor of 9003.41 was cleaned of rust and painted two coats of linseed oil and white lead, cream color. This necessitated low scaffolds. The square yards in which the unit cost is reported are the yard measurements derived from developing the plate. This cost covers the material and the labor.

Account 9003.43—Painting Top Main Floor.

This account covers the labor and material used in painting the upper surface of the power house Berger plate concrete floor. It was given two coats of Toch Brothers cement filler and one coat Toch Brothers warm gray cement paint, after the floor had been well cleaned and dried out.

Account 9003.5—Berger Multiplex Plate.

This account covers the material and labor used in putting Berger plate upon the power-house roof. The eaves of the roof are 41 ft. from the ground and the floor is $\frac{1}{4}$ pitch. The Berger plate was hoisted

to place by use of a single pulley and hand rope. When laid in position it was wired to the purlins with No. 10 wire. The segregated account stands as follows:

| | |
|-------------------|------------|
| Berger plate..... | \$2,962.25 |
| Wire..... | 20.41 |
| Tools, etc..... | 80.52 |
| | <hr/> |
| | \$3,063.18 |

(See Fig. 56.)

Account 9003.51—Roof Concrete.

This account covers the concrete placed on the roof. It was hoisted to the eaves at various places and transported to position in hand buckets. The concrete was hand mixed, 5 sand and gravel to 1 cement. The top finish was not used, but the concrete was straight-edged to proper level and troweled as smooth as possible. (See Fig. 56.)

Account 9003.52—Roof Tar.

This account covers the cost of the material below, and the labor used in applying it to the roof. A composition of tar, cement and coal oil was made and painted directly upon the concrete roof in an effort to make it waterproof.

| | |
|--------------------------|----------|
| 11 barrels of tar..... | \$113.74 |
| 7 sacks cement..... | 4.95 |
| 54 gallons coal oil..... | 6.48 |
| Miscellaneous..... | 2.56 |
| | <hr/> |
| | \$127.73 |

Account 9003.53—Roof Down Spouts and Tile Drain.

This covers the cost of the material used in 10 down spouts and drains, together with the labor employed in erecting them. The down spouts are 4-in. galvanized iron spouts which, after leaving the gutters, pass directly through a hole prepared in the building wall to the inside of the building, and thence to the basement floor. At this point they enter a 4-in. vitrified sewer pipe which is laid beneath the floor discharging into the drain down the center of the building. The material account stands as follows:

| | |
|---|----------|
| 355 ft. 4-in. vitrified sewer pipe..... | \$117.90 |
| 550 ft. 4-in. galvanized iron drain pipe..... | 90.87 |
| Miscellaneous..... | 31.67 |
| | <hr/> |
| | \$240.44 |

Account 9003.54—Roof Painting Underside.

This account covers the cost of the paint material, brushes, scaffolds, etc., together with the labor required to paint the underside of the

power-house roof. High swinging scaffolds from the roof truss purlins were used to work from. They were slow and difficult to move from place to place. The rust was cleaned off and it was given two coats of white lead and linseed oil, cream color.

Account 9003.55—Roof—P and B Roofing.

This account covers cost of material and labor incident to applying a paper roof. Wood strips were imbedded in the concrete around the base of each ventilator, and across the roof at the juncture of the lean-to roof with the main building roof. A cement coating was then applied to the concrete followed by application of hot maltha, with sheets of felt imbedded in the maltha. The felt was so lapped one piece upon another as to give three thicknesses over the entire roof. Another application of hot maltha was swabbed over this ground work, followed by one course of three-ply P and B roofing paper.

Account 9003.60—Painting Sash.

This account covers the material and labor incident to painting all the power-house sash three coats. Linseed oil and white lead was used.

Account 9003.61—Painting Woodwork.

This account covers the painting of the power-house doors and miscellaneous woodwork.

Account 9004—Crane.

This crane has a capacity of 20 tons. It is operated by hand and spans the power-house floor, a distance of 50 ft. It has a 40-ft. lift and runs on 50-lb. rails. The account covers the material as shown below, and the labor of erecting the crane:

| | |
|--------------------------------------|------------|
| One 20-ton hand traveling crane..... | \$1,278.00 |
| Freight on same..... | 408.00 |
| Miscellaneous..... | 37.27 |
| | <hr/> |
| | \$1,723.27 |

Account 9005—Well Grading.

This covers the cost of grading off a point of conglomerate rock in preparing a site for a well. Large blasts of dynamite were used.

Account 9005.1—Shaft Sinking.

This covers the cost of sinking a shaft in conglomerate at the waters edge upon the site prepared by account 9005. The shaft was 6 ft. by 8 ft. and went to a depth of 45 ft. It was necessary to install and run a No. 7 Cameron pump to handle the water.

Account 9005.2—Timbering.

The timbers used were 8 in. by 8 in., Oregon pine square-shaft sets, making two compartments in the shaft. The shaft was lagged.

Account 9005.31—Aldrich Pump Installation.

The money expended under this account was for unloading two pumps which were not installed.

Account 9006.01—Nordberg Blowers—Foundation.

These two concrete foundations were each about 30 ft. by 15 ft. by 20 ft. The concrete was mixed 6 parts sand and gravel to 1 cement by machine, and transported 50 ft. to place. 100 per cent. of the vertical surface was formed. Each foundation had over thirty bolts set exact with template and piped. The pipes were in short pieces pulled up as the foundation raised and out at the completion. The cost of these pipes and the bolts are in every case given in the concrete cost. (See Fig. 49.)

Account 9006.1—Nordberg Blowers Cost and Installation.

This account covers the cost of the material as listed below, together with the labor of erecting the same. These engines are two Nordberg cross-compound blowing engines, designed to compress 10,000 cu. ft. of free air at an altitude of 3,500 ft. to 12 lb. pressure, while 15 lb. may be carried if desired. The high-pressure steam cylinder is 20 in., the low-pressure 42 in., while the air cylinders are 44 in., all having the common stroke of 42 in. The engines are furnished 160 lb. steam pressure, superheated 75° F. The speed is 71 r.p.m. The labor of grouting, and the labor of testing out and starting up are included here.

| | |
|---|-------------|
| 2 Nordberg blowing engines, with receivers..... | \$30,967.34 |
| 2 No. 34 crane tilt traps..... | 107.78 |
| Grout, etc..... | 1,438.90 |
| | <hr/> |
| | \$32,514.02 |

Account 9006.2—Nordberg Blowers Painting.

This account covers the cost of material and labor of painting the two Nordberg blowing engines. All of the power-house machinery was painted by contract for the sum of \$820. This sum covered the labor and all tools, such as brushes, putty knives, light ladders, etc. The paint, oils, colors, dryers, and scaffolds where necessary were furnished by the company. The money covered by the contract and material used was apportioned to the painting account of the different pieces of machinery on the basis of the time spent on each piece of machinery. Every machine was given one coat of paint, one coat of filler, and two coats of olive-green enamel.

Account 9007.01—Turbines—Foundation.

This concrete is identical with 9006.01.

Account 9007.1 Turbines—Cost and Installation.

This account covers the purchase price of three Curtis turbines and material as listed below, together with the labor of erection, grouting, wiring from generator to switchboard, testing and starting up. The turbines are 2,000-k.w. Curtis-type horizontal shaft engines and direct connected to 2,500-k.v.a., 6,600-volt, 60-cycle, 3-phase, 1,900-r.p.m. generators. The approximate size of each unit is 23 ft. 8 in. long by 10 ft. 6 in. wide by 9 ft. 7 in. high, with a net weight of 108,300 lb.

| | |
|--|-------------|
| 3 turbines..... | \$77,828.10 |
| 486 gallons of gargoyle turbine oil..... | 233.04 |
| Grout, electrical material..... | 1,525.35 |
| | <hr/> |
| | \$79,586.49 |

Account 9007.2—Turbines—Painting.

See account 9006.2.

Account 9007.3 Turbines—Air Pipe Making.

(See Fig. 57.) This account covers the making of the air ducts for the three turbines. They were fabricated in the smelter shops of No. 16 steel with $2\frac{1}{2}$ by $2\frac{1}{2}$ by $\frac{1}{4}$ angles. The total length for the three was 103 feet.

Account 9007.4—Turbines—Air Pipe Erection.

This account covers the labor of erecting the air ducts in account 9007.3. The material used was cloth insertion packing, rivets, hangers, anchors, etc.

Account 9007.51—Transformer Trucks and Transfer Table.

This account covers the placing of 325 ft. of 40-lb. rail for installing 15 transformers with trucks, and the cost of those trucks. (See Fig. 58.)

Account 9007.52—Auto Transformers.

This account covers the cost of the 10 transformers oil and wire as listed below, together with placing wiring, trying out and testing the same.

| | |
|---|-------------|
| 10 oil-cooled auto transformers for raising voltage from 6,600 to 13,200 volts, G.E. Type "H," 60 cycles..... | \$11,801.81 |
| 417 k.v.a. Y connected. (3 transformers to a turbine and one spare). | |
| Oil and wire..... | 243.10 |
| | <hr/> |
| | \$12,044.91 |

Account 9008.01-- Condensers --Foundation.

These were plain foundations machine mixed, in the proportions of 1 cement to 6 sand and gravel. The vertical surfaces were 100 per cent. formed.

Account 9008.1--Condensers --Cost and Installation.

This covers the cost of 3 Alberger surface condensers and the labor of placing and grouting them in position. Each condenser has 7,600 sq. ft. of surface.

| | |
|--------------------|-------------|
| 3 Condensers..... | \$19,436.04 |
| Grouting, etc..... | 127.51 |
| | <hr/> |
| | \$19,563.55 |

Account 9008.2--Condensers Painting.

See account 9006.2

Account 9009 --Jet Condenser Hot Well Excavation.

This covers the cost of making small excavations for a few piers in red clay with pick and shovels.

Account 9009.01 Jet Condenser Hot Well Foundation.

This covers a small amount of concrete for piers, hand mixed-- 6 sand and gravel to 1 cement.

Account 9009.02 Jet Condenser Hot Well Supporting Structure and Tank.

This account covers the cost and erection of 5.76 tons of steel. There was a quadrangular tower 19 ft. 6 in. high, with about 12 ft. base, surmounted with a 10 ft. diameter by 8 ft. 6 in. high steel tank. It was furnished by the Kansas City Structural Steel Co.

Account 9009.03 Jet Condenser Cost and Erection.

This covers the cost of one 28-in. Alberger type "F," barometric jet condenser and erection above the tank of account 9009.02.

Account 9009.12 --Jet Condenser Dry Vacuum Pumps.

These air pumps remove the air from the barometric condenser and are located in the power house. The account covers the cost of the material listed below and the labor of erecting the same.

| | |
|--|------------|
| Two 15-h.p. slip ring motors, 440 volts, 3 phase, 60 cycles, 565-r. p. m., with resistance controllers..... | \$739.92 |
| Two 16 by 12 single-stage Alberger dry vacuum pumps..... | 1,888.82 |
| 2 circuit breakers..... | 39.88 |
| Grout, cable, condulets, etc..... | 191.99 |
| | <hr/> |
| | \$2,860.01 |

Account 9009.13—Jet Condenser Dry Vacuum Pump—Painting.
(See account 9006.2.)

Account 9009.21—Circulating Pumps—Foundation.

These are about 15 ft. by 20 ft. by 10 ft. and are similar to 9006.01 in other respects.

Account 9009.22—Circulating Pump—Cost and Erection.

These air pumps furnish the circulating water for the barometric condenser. The cost here includes the price of the material listed below and the labor installing the same.

| | |
|--|------------|
| Two 35-h.p., 440-volt, 60-cycle, 570-r.p.m. motors, | \$1,687.50 |
| Two 2 Lobe cycloidal jumps, 14 by 12, 17.8 gal. per rev. | 2,341.41 |
| 2 oil switches, 660 volt. | 39.89 |
| Miscellaneous. | 66.88 |
| | <hr/> |
| | \$3,535.68 |

Account 9009.23—Circulating Pumps—Painting.

See account 9006.2.

Account 9010.01—Air Compressor—Foundation.

This concrete is 10 ft. by 20 ft. by 15 ft. high. In other respects it is similar to 9006.01.

Account 9010.02—Air Compressor—Erection.

This account covers only the erection at the smelter of the following Ingersoll-Rand two-stage compressor. It was bought from the mines and erected at the smelter power house. The compressor has a steam-driven cross-compound Corliss engine. The steam cylinders are 13 in. and the air cylinders are 22 in. and 13 in. and the common stroke is 36 in.

Account 9010.04—Air Compressor—All Piping Except Steam.

This account covers the cost and erection of all the piping to the Ingersoll-Rand Co. compressor except the steam piping.

Account 9010.05—Air Compressor—Wrecking and Transportation.

This account covers the labor of tearing down this compressor at Morenci, loading it on cars and the freight to the smelter. Such material is charged as was incident to these operations.

Account 9010.06—Air Compressor—Installation of Air Receivers.

This account covers the labor of installing a small air receiver in the power-house basement, for the compressor. No charge was made for the receiver.

Account 9011.01—Two Exciters, Two Air Pumps, Two Circulating Pumps—Foundation.

This is a large foundation about 15 ft. by 20 ft. by 10 ft. In other respects it is the same as account 9006.01.

Account 9011.02—Two Exciters— Cost and Installation.

This account covers the cost of the material listed below and the labor of installing the same. These are the exciters for the turbine generators. They are Ridgway tandem, compound, balanced, slide-valve engines, direct connected to 75-k.w., 125-volt direct-current generators with a speed of 275 r.p.m.

| | |
|---------------------|------------|
| 2 exciters..... | \$5,744.96 |
| Cable wire etc..... | 286.28 |
| Miscellaneous..... | 87.02 |
| | <hr/> |
| | \$6,118.26 |

In the labor cost is included wiring and connecting the machines to the switchboard, as well as erecting grouting and trying out.

Account 9011.03—Three Dry Vacuum Pumps— Cost and Installation.

These pumps are for the surface condensers. The account covers their cost, erection, grouting and trying out. They weighed 14,000 lb.

| | |
|--|------------|
| 3 dry vacuum pumps 8-in. steam by 20-in. air by 12-in. stroke. | \$3,136.11 |
| Grout, packing, etc..... | 53.99 |
| | <hr/> |
| | \$3,190.10 |

Account 9011.04— Three Circulating Pumps and Engines— Cost and Installation.

These pumps furnish the circulating water for the surface condensers. This account covers the cost of the material listed below and the labor of erecting and trying out.

| | |
|---|------------|
| 3 Lobe, 18 by 20, cycloidal pumps, capacity 49.5 gallons per rev., and Three 27-in. flexible couplings..... | \$4,425.25 |
| Three 11 by 14 Ridgway, simple balanced, slide-valve engines for direct connection to above pumps | 4,124.60 |
| Grout, packing, etc..... | 179.43 |
| | <hr/> |
| | \$8,729.37 |

Account 9011.05—Two Exciters— Painting.

See account 9006.2.

Account 9011.06—Three Air Pumps— Painting.

See account 9006.2.

Account 9011.07—Three Circulating Pumps— Painting.

See account 9006.2.

Account 9012.01—Two Motor Generators, One Air Pump, One Circulating Pump—Foundation.

These foundations are 28 ft. by 18 ft. by 11 ft. In other respects they are similar to 9006.01.

Account 9012.02—Two Motor Generators—Cost and Installation.

This account covers the material listed below as well as the labor of unloading, erecting, grouting, wiring to switchboard, and trying out.

| | |
|---|------------|
| Two 150-k.w. synchronous motor-generator sets to supply 250 | |
| volt d.c..... | \$6,450.16 |
| Conduit and wire..... | 317.36 |
| Miscellaneous..... | 62.81 |
| | <hr/> |
| | \$6,830.33 |

Account 9012.05—Two Motor Generators—Painting.

See account 9006.2.

Account 9013—Transfer Table Pit—Concrete.

This is principally a plain concrete slab, 8 in. thick, mixed by hand in the proportions of 6 sand and gravel to 1 cement. About 10 per cent. of the vertical surface was formed. It was chuted to the basement and wheeled in barrows 100 ft. to place.

Account 9013.01—Switchboard—Concrete Compartments.

This is a concrete switchboard, the large dimensions of which are 40 ft. 4 in. long, 4 ft. wide and 13 ft. 2 in. high. Down the center of the board is a 4-in. wall and on each side are 30 pockets made with 2-in. dividing walls. Reinforcing was done with Clinton wire mesh in the 4-in. wall and $\frac{1}{4}$ -in. and $\frac{3}{8}$ -in. rods were used elsewhere. A great many bolts and insulators were set in the board. The entire board was cast sectionally in place, using 5 parts of sand and gravel to 1 part cement. This cost includes rubbing down the concrete with pumice stone and filling all the air bubble holes and small voids.

Account 9013.02—Switchboard—Cost and Erection.

This account covers the material price of the secondary switchboard slabs. The primary or concrete switchboard construction, however, is in account 9013.01. Here, too, is the material price of the entire equipment for all of the switchboards, both primary and secondary, and the labor of installing the same.

Account 9014—Steam Piping North and South Mains—Excavation.

This covers the excavation for numerous piers done with pick and shovel and cast to one side.

Account 9014.01—Steam Piping North and South Mains—Fo

This concrete composes the piers which support the long steel steam pipe supports. They were part mixed by machine by hand, in the proportions of 6 sand and gravel to 1 cement. 50 per cent. of the vertical surface was formed.

Account 9014.02—Steam Piping North and South Mains—Steeling Structure.

In these steam-pipe trestle supports 11.8 tons of corrugated 75.01 tons of structural steel were used. (See Fig. 60.)

Account 9014.03—Steam Piping Mains, Hangers and Anchors.

This covers the cost of material and making of all hangers and used for the steam piping between the boilers and the machine power house. The hangers were made of $\frac{3}{4}$ -in. rods and $\frac{1}{2}$ -in. clamps running around pipe. Anchors were of same material created to suit conditions surrounding place used. (See Figs. 60

Account 9014.04—Steam Piping—Cost and Erection.

Under this account all the material listed below is costed, with the labor of its erection. These pipes run from the boiler power house in duplicate, making a complete loop about around. The main lines are 10 in. branches from boilers to branches to engines of suitable size ranging from 4 in. to 8 in. joints are Van Stone, all valves and fittings are of cast steel. line is required to stand 180 lb. pressure with 100° F. superheated gaskets used are corrugated bronze. The 10-in. lines are fitted with six 10-in. Harter expansion joints. (See Figs. 60 and 61.)

| | |
|---|---------|
| Six 10-in. Harter expansion joints..... | \$1,684 |
| One 6-in. cast-iron separator..... | 120 |
| Two 10-in. cast steel vertical separators..... | 843 |
| One 10-in. cast steel horizontal separator..... | 372 |
| Two 6-in. separators and receivers (bot. outlet)..... | 591 |
| One 5-in. cast steel separator and receiver (bot. outlet) .. | 261 |
| Three 4-in. cast steel separators and receivers (bot. outlet) | 687 |
| Two 4-in. cast steel separators and receivers (bot. outlet) | 476 |
| Corrugated bronze gaskets..... | 251 |
| Ten 8-in. Lagonda valves..... | 1,315 |
| Twelve 10-in. gate valves..... | 2,079 |
| Two 34-in. and one 33-in. Crane tilt traps..... | 143 |
| Best Mfg. Co. pipe and fittings..... | 8,738 |
| Extra pipe and fittings..... | 520 |
| Miscellaneous..... | 522 |

\$18,622

Account 9014.05—Steam Piping—Covering and Erection.

Part of this work was contract by the people who furnished the material and part was force account. Therefore the material figure given covers a large portion of labor. The total unit cost is the only valuable unit. The steam lines and all fittings were all covered with 85 per cent. magnesia blocks of double standard thickness, wrapped with 6-oz. duck. All of the line was then painted two coats—cream color.

Account 9015—Exhaust Pipe—Cost and Erection.

This covers the cost of the material as listed below and the labor incident to installing it. Some of the piping is cast iron, designed for a vacuum of 14 lb. per square inch. The rest of the piping is lap-welded wrought steel with cast-iron fittings. The installation covers the three 20-in. atmospheric exhausts from the turbines, as well as the exhaust from the blowers, compressors, exciters, engines, and circulating pump engines, to the jet condenser. It covers likewise the connections between the exhaust of the dry vacuum pumps, exciters, engines, surface condenser circulating pumps and the heater house. The pipe ranged in size from 3 in. to 42 in.

| | |
|--|------------|
| Three 42 by 13 Wainwright turbine expansion joints.... | \$656.70 |
| Three 20-in. atmospheric relief valves..... | 804.50 |
| Three 42-in. low-pressure flanged base elbows..... | 1,428.61 |
| Three special 8-in. emergency stop valves..... | 234.36 |
| One 14-in. automatic atmospheric exhaust relief valve... | 123.27 |
| Pipe and fittings..... | 4,585.74 |
| Miscellaneous..... | 882.48 |
| | <hr/> |
| | \$8,715.66 |

Account 9015.01—Exhaust Pipe—Painting.

All exhaust pipe was given one coat of green silica graphite paint.

Account 9015.05—Exhaust Pipe—Covering and Erection.

The exhaust pipe from the engines in the power house to the heater house were all covered with 85 per cent. magnesia single standard thickness, wrapped in 6-oz. duck. Where the magnesia is exposed to the weather, it is wrapped with No. 28 galvanized iron. This account covers the labor and material incident to the above work. (See Fig. 62.)

Account 9015.10—Air Piping—Cost and Erection.

This is not a valuable cost.

Account 9015.11—Air Pipe—Painting.

This covers the painting of 9015.01. It is of no value.

Account 9015.2—Exhaust Pipe—Foundation.

This covers a number of small concrete piers.

Account 9015.21 Exhaust Pipe Supporting Structure.

This account covers the cost of a number of exhaust pipe hangers, supports and staging used in erecting exhaust pipe. It is not a good cost.

Account 9015.22 Exhaust Pipe Excavation.**Account 9016 Water Pipe Excavation and Backfill.**

This account covers the excavation of a trench about 3 ft. deep, through red clay and boulders, for a 16 in. wood stave pipe and the backfill after the laying of the pipe.

Account 9016.01- Water Pipe Cost and Erection.

This account covers the cost of all the material listed below and the labor of its installation. Here is listed all the water piping about the power house the 30 in. cast iron suction pipe line from the cooling tower to the pumps; the 20 in. wooden lines from the pumps to the equalizing tank; the 16-in. wooden line from the jet condenser to the cooling tower, and the 16-in. wooden lines from the equalizing tank to the cooling tower; the 12 in. cast iron lines from the circulating pumps to the jet condenser; the 8-in. line from condenser to condensed water pump house; the 6-in. line from condensed pump house to heater house, etc. (See Fig. 63.)

| | |
|--|-------------|
| 1998.7, 4-in. machine banded redwood pipe with collars. (Not used at New Smelter). | \$397.74 |
| 354.6 ft. 20-in. machine banded redwood pipe with collars | 365.24 |
| 1,104.2 ft. 16-in. machine banded redwood pipe with collars. | 861.28 |
| 22 flanged couplings | 590.00 |
| Freight on the above items | 632.00 |
| Two 12-in. check valves | 97.00 |
| Four 12-in. gate valves | 172.00 |
| Three 20-in. gate valves | 283.50 |
| Freight on the above items | 176.38 |
| Three 20-in. flanged, iron body, bronze mounted, double gate valves. . . | 403.49 |
| Five No. 20 gauge copper plates | 36.28 |
| Two cast-iron bell and flange fittings, 6 bell bends | 81.11 |
| Freight and patterns on above | 78.00 |
| 220 lb. cloth insertion packing | 91.50 |
| Best Mfg. Co. pipe. | 9,668.92 |
| Pipe, fittings, misc'l material | 2,503.44 |
| | <hr/> |
| | \$16,437.88 |

Account 9016.02 Water Pipe Painting.

This covers the painting of the pipe in 9016.01 that was above the ground.

Feed Water Heating Plant

Account 9017—Excavation.

This covers the excavation of the sump and piers, of the feed water heating plant. The material was red clay, with boulders and sand and gravel. The work was done with pick and shovel, cast into carts and hauled 300 ft.

Account 9017.01—Foundation.

This account covers some miscellaneous concrete cast as piers, low reinforced walls, 4 in. to 8 in. thick, and floor slabs. The walls and slab were reinforced with $\frac{3}{8}$ -in. rods on 6-in. centers. The concrete was hand mixed in the proportion of 6 sand and gravel to 1 cement and wheeled 50 ft. in barrow to the forms. Seventy-five per cent. of the vertical surface was formed.

Account 9017.015—Reinforced Floors and Stair Treads.

These floors were cast over I-beams in the building structure by using forms which allowed the encasing of the I-beams with concrete. The stairs were structural steel with channel treads. The treads were filled with concrete. The floor and the treads were reinforced with $\frac{1}{4}$ -, $\frac{3}{8}$ - and $\frac{1}{2}$ -in. rods variously used and spaced. The concrete was hand mixed in the proportions of 5 sand and gravel to 1 cement, hoisted from the ground 20 ft. to place by means of a small air hoist. (See Fig. 65.)

Account 9017.016—Waterproofing Concrete Tanks.

This consisted of plastering the inside of the concrete tanks at the heater house with the following mixture. One cubic foot cement, 2.5 cu. ft. sand, 1 lb. Medusa waterproof compound mixed with sufficient water. The account covers the labor and material.

Account 9017.02—Steel Structure.

There were 26.63 tons of structural steel in this building.

Account 9017.021—Distribution and Equalizing Tank.

This account covers the material labor of fabrication and erection of this tank. Its dimensions are 13 ft. by 13 ft. by 5 ft. high. It has 8 holes in the bottom averaging 20 in. in diameter. It is located on a concrete floor base 23 ft. off the ground. The weight of the tank is 4,800 in. A material list shows the following. (See Fig. 69.)

| | |
|---|----------|
| 17 sheets steel $\frac{1}{4}$ in. by 48 in. by 120 in..... | \$192.96 |
| 4 pieces angle iron 3 in. by 3 in. by $\frac{3}{8}$ in. by 20 ft. long..... | 15.15 |
| 1.110 b.m. lumber..... | 31.55 |
| Rivets, bolts, nuts, etc..... | 20.89 |

\$260.58

Account 9017.03 Tile Work.

The walls were started on the concrete floor of the feed water heating plant at an elevation of 26 ft. from the ground. The material was hoisted up by means of a small air hoist. In other respects this account is similar to the tile work elsewhere about the plant.

Account 9017.031 Unloading Tile.

Same as 9003.11.

Account 9017.032 Coping.

Same as account 8703.22.

Account 9017.033 Sills and Lintels.

The concrete sills and lintels for this building were separately moulded as 8821.3, which see. The sills are 3 in. by 8 in. by 3 ft. 9 in. and the lintels 4 in. by 8 in. by 3 ft.

Account 9017.034 Painting Tile Walls.

The tile walls were given one coat of Bay State cement paint after the small holes had been filled and mortar cleaned from the face of the brick.

Account 9017.035 Doors, Windows and Frames.

This account covers the cost of the doors, windows and frames set in place. A segregated material list is as follows. (See Fig. 70.)

| | |
|--|---------|
| 3 doors 2 ft. 10 in. by 6 ft. 10 in. by 1 $\frac{1}{2}$ in. with frames | \$20.86 |
| 7 windows, 2 ft. 9 $\frac{1}{2}$ in. by 5 ft. 9 in. by 1 $\frac{1}{2}$ in. with frames | 59.88 |
| 12 sets Caldwell sash balancers, nails, locks, etc. | 19.24 |
| | <hr/> |
| | \$99.98 |

Account 9017.04 Roofing.

This account covers the material listed below, and the labor of installing the same. The wood sheathing was nailed directly to nailing strips attached to the purlins. The paper was laid over the sheathing. (See Fig. 72.)

| | |
|--|----------|
| Two 166 b.m. 2 by 8 Oregon pine SISE | \$47.60 |
| 10 squares asbestos roofing. | 49.00 |
| Miscellaneous | 13.28 |
| | <hr/> |
| | \$109.88 |

Account 9017.045 Ventilators.

This account covers the material used to make two 3 ft. 6 in. diameter ventilators, and the labor of installing one. The ventilators were made of No. 18 gauge galvanized iron. (See Fig. 71.)

Account 9017.05 Treating Tank Concrete.

This is a concrete tank 8 ft. in diameter by 31 ft. 3 in. high, with a conical bottom, the tank is set directly upon the ground. The concrete

was mixed by hand 5 parts sand and gravel to 1 cement, and hoisted to place. The wall of the tank is 5 in. thick suitably reinforced in both directions with $\frac{5}{8}$ -in. rods. Two sets of forms were used each 3 ft. 3 in. high. This cost covers all the material and labor of building this tank save the waterproofing in 9017.016. (See Fig. 68.)

Account 9017.06—Receiving Tank No. 1.

This is a concrete tank 6 ft. 6 in. high with 5-in. walls, suitably reinforced in both directions. The tank rests on a concrete floor about 23 ft. from the ground. The concrete details are the same practically as 9017.05. (See Fig. 67.)

Account 9017.07—Receiving Tank No. 2.

This concrete tank is 12 ft. in diameter, 6 ft. high, with 5-in. reinforced wall, supported on reinforced concrete columns 7 ft. high. The column are here included. In other respects the tank account is similar to 9017.06. (See Fig. 66.)

Account 9017.08—Calibrating Tank.

This account covers the material, fabrication, and cost of erecting the following tank:

1 tank 54 in. high, 6 ft. diameter, of $3\frac{3}{16}$ -in. plate.

Account 9017.081—Tipping Meter.

This account covers the cost of material as listed below and the fabrication and erection of the same. The tipping meter is set directly over No. 2 receiving tank, in a wood frame attached to the top of the tank. The meter is shown in sketch No. 136.

| | |
|--|---------|
| Lumber, 2 by 4's, 6 by 8's, etc., 876 b.m..... | \$24.47 |
| Galvanized iron No. 10 and No. 12..... | 112.03 |
| 2 by 2 by $\frac{1}{2}$ angle iron..... | 3.69 |
| One 6 wheel revolution counter..... | 34.74 |
| Bolts, washers, nails, etc..... | 52.57 |

\$227.50

Account 9017.09—Heater and Recorder.

This account covers the material listed below and the labor of installing it on the concrete floor of the feed water heating plant, 26 ft. off the ground. The magnesia blocks are the covering for the heater.

| | Factory | Freight | Clifton |
|---|----------|----------|----------|
| 1 No. 760 Cochrane feed water heater and receiver | \$776.75 | \$204.48 | \$981.23 |
| 1 Wainwright closed feed water heater..... | 775.00 | 74.64 | 849.64 |
| One 6-in. Lea recorder and extra float valve..... | 589.00 | 123.51 | 712.51 |
| One 6-in. float for receiving tank No. 2..... | | | 44.60 |
| 600 sq. ft. magnesia blocking $1\frac{1}{2}$ in. thick..... | | | 161.03 |
| 300 lb. magnesia cement..... | | | 22.53 |
| Miscellaneous..... | | | 42.30 |

\$2,813.84

Account 9017.1.—Sewer Excavation and Backfill.

This was a long trench about 3 ft. deep through red clay and boulders. Both excavation and backfill are here taken care of.

Account 9017.11.—Sewer Pipe—Cost and Laying.

This covers the cost of 100 ft. of 24-in. vitrified sewer pipe, cement and miscellaneous material, together with the labor of laying the same.

Account 9017.1.2—Lighting.

This covers the cost of wiring for lights in the feed water heating plant.

Account 9017.13 —Painting.

This covers the cost of painting the underside of the roof, doors, all frames, and window sash. It was done with two coats of white lead and linseed oil, cream color.

Account 9017.14 —Wood Walkway and Tank Covers.

This covers the cost of material and its installation as listed below:

| | | |
|-----------------------|---|------------------------------|
| Lumber 1,564 ft. b.m. | { | tank cover 1 by 6 O.P. SISIE |
| | | rails 2 by 3 and 3 by 3 S4S |
| | | sills, 2 by 8 ROP 20 in. |
| | | centers on tank |
| | | walkways 2 by 8 O.P. SISIE |

Account 9017.115 —Alterations.**Condensed Water Pump House****Account 9017.20 —Excavation.**

This was a side hill cut. It includes a backfill made later inside the building foundation for a concrete floor base. The excavation was in red clay, with boulders and sand and gravel. It was done with pick, shovels and wheelbarrows.

Account 9017.21 —Foundation.

This concrete was cast as the walls of some square tanks. It was reinforced, mixed by hand in the proportions of 5 sand and gravel to 1 cement. One hundred per cent. of the vertical surface was formed. (See Figs. 73 and 74.)

Account 9017.2 — Floor.

This concrete covers the small building walls, large side hill wall, floor slab and tank bottom. Three-eighth inch and three-fourth inch rods were used as reinforcing. One hundred per cent. of the vertical surface was formed. Hand-mixed concrete, 5 sand and gravel to 1 cement, was used.

Account 9017.24—Doors, Windows and Frames.

This account covers the cost of material below with its installation.

| | |
|---|---------|
| 2 windows 2 ft. 9 $\frac{5}{8}$ in. by 1 $\frac{3}{4}$ in. glazed, with factory ribbed glass. | \$6.51 |
| 2 frames for above..... | 9.28 |
| 1 door 2 ft. 10 in. by 6 ft. 10 in. by 1 $\frac{3}{8}$ in..... | 3.02 |
| 1 door frame..... | 3.87 |
| | <hr/> |
| | \$22.68 |

Account 9017.242—Tile Work.

This covers the cost of tile, mortar, mason and carpenter labor and hauling. The tile was handled 400 ft.

Account 9017.243—Coping.

Same as 8703.22.

Account 9017.25—Roof.

This account covers the material entering into the roof frame, as well as the sheathing paper and labor of installing the same. The rafters were 2 by 10, with 2 by 8 sheathing tongued and grooved, covered with asbestos paper. (See Fig. 75.)

| | |
|--|---------|
| 984 ft. b.m. lumber..... | \$33.49 |
| 5 rolls asbestos composition roofing paper | 24.50 |
| Nails, etc..... | 2.84 |
| | <hr/> |
| | \$60.83 |

Account 9017.26—Pumps and Piping.

This account covers the purchase price of the material listed below and the entire labor cost required in installing the same.

| | |
|---|------------|
| 2 Goulds No. 2 $\frac{1}{2}$ single stage, single side suction, centrifugal pumps, arranged for direct connection, capacity of pump 200 gallons per minute, against 80 ft. head | } \$530.83 |
| Two 10-h.p. induction motors, 1,710 r.p.m., with starters..... | |
| Grouting, pipes, fittings, valves, etc..... | 160.54 |
| | <hr/> |
| | \$691.37 |

Account 9017.27—Lighting.

This covers the lighting of the condensed water pump house.

Power House Miscellaneous Accounts**Account 9018.1—Power and Lighting Transformers.**

This account covers the material as listed below, with the labor charge of installing the same, the labor of unloading, erecting, connecting up, drying out, and testing the transformers noted. These are located in the basement of the power house.

| | |
|--|----------|
| 2 Burke air break switches..... | \$134.97 |
| Four 200-k.v.a. transformers, 13,200-volt, 440-volt..... | 2,999.80 |
| Two 20-k.v.a. transformers, 440-volt, 220-volt..... | 304.40 |
| One 20-k.v.a. transformer, 440-volt, 110-volt..... | 152.18 |
| Freight on transformers..... | 90.48 |
| Wire, conduit, electrical material..... | 614.04 |
| Transformer oil..... | 282.34 |
| Miscellaneous..... | 136.12 |

\$4,714.33

Account 9019—Lighting.

This account covers the material and labor of installing the lighting in the power house. The work was all in conduit.

Forty-eight 250-watt tungstens with reflector.

Forty-six 16-c.p. carbon lamps.

610 ft. 1½-in. conduit with weatherproof wire No. 12.

1,710 ft.- 1-in. conduit with No. 12 weatherproof wire.

25 ft. brewery cord.

Account 9020—Power House Oiling System.

This covers the cost and labor of installing the power house oiling system. Two 60-gallon feed tanks are so located that the oil is piped to all the engines by gravity. The waste flows to a water separator, thence through filters into a closed tank, from whence by air pressure it is forced up to the feed tanks.

Account 9021—Benches, Bolt Racks, Etc.

Under this account were built a number of benches, a rack for bolts, a telephone booth, wrench board, and a number of miscellaneous carpenter jobs about the power house including the replacing of about 50 broken panes of glass. The material account stands as follows:

| | |
|---------------------|--------|
| Ceiling lumber..... | \$8.23 |
| Common lumber..... | 31.24 |
| Grass..... | 6.39 |
| Miscellaneous..... | 5.94 |

\$51.80

Account 9022—Instruments and Gauges.

This account covers the purchase price of the following material, and the labor of installing the same:

| | |
|--------------------------------|---------|
| 3 Tagliabue vacuum gauges..... | \$92.58 |
| 10 Tagliabue thermometers..... | 92.85 |
| 1 vacuum gauge..... | 30.86 |
| 1 Bristol pressure gauge..... | 25.30 |
| 1 Bristol gauge..... | 22.95 |
| 1 Bristol gauge..... | 21.35 |
| 1 clock..... | 46.63 |
| Miscellaneous..... | 10.54 |

\$343.06

Cooling Tower

Account 9050—Excavation.

This excavation entailed the making of a surface cut and two long trenches. The material encountered was red clay filled with caliche. It was done with pick and shovel and handled in carts and wheelbarrows.

Account 9050.01 Backfill.

This backfill was made to bring the ground up to proper level for the cooling tower floor. Fresnoes and scrapers were used to transport the dirt which was tamped in 4-in. layers.

Account 9051—Foundations—Sumps and Gutters.

This concrete was cast as a large number of piers about 1 ft. by 1 ft. by 4 ft. as a sump 35 ft. by 10 ft. by 13 ft. with reinforced walls 8 in. thick, and as two gutters 626 ft. long, in cross section about 3 ft. by 3 ft. having 4-in. reinforced concrete walls. The concrete was hand mixed; for the piers 7 sand and gravel to 1 cement; for the gutters and sump, 5 sand and gravel to 1 cement. In the sump $\frac{3}{4}$ - and $\frac{5}{8}$ -in. rods were used and in the gutters $\frac{1}{2}$ -in. The vertical surfaces of all the above were 100 per cent. formed. (See Fig. 107.)

Account 9051.02—Floor.

Between the gutters of the cooling tower is a reinforced concrete slab about 28 ft. 6 in. by 600 ft. by 4 in. thick. Clinton wire cloth 86 in. wide with a 4 in. by 4 in. mesh was used. No top finish was used but the concrete was straight edged and troweled. It was mixed by hand, 5 sand and gravel to 1 cement, and wheeled 150 ft. to place, in barrows. (See Fig. 107.)

Account 9051.03—Waterproofing Concrete.

See account 9017.016.

Account 9052—Woodwork.

The tower is built of wood and is 626 ft. long 35 ft. 6 in. wide at the base, by 20 ft. 6 in. high. Sketch No. 76 shows the design in other particulars.

Account 9053—Alterations.

Oil Supply Sump and Pump House

Account 9060—Excavation.

This excavation consisted of two deep cuts through red clay and boulders into sand and gravel. The work was done with plow, slips, picks and shovels.

Account 9060.01—Concrete.

This covers the making of a covered reinforced concrete sump, the general dimensions of which are 5 ft. by 10 ft. by 140 ft. with walls 8 in. thick—top and bottom slab $5\frac{1}{2}$ in. thick, also a pump house about 20 ft. by 20 ft. by 20 ft. high, with walls 10 in. at top and 20 in. at bottom. The walls were reinforced with $\frac{3}{4}$ -in. rods and the sump with $\frac{5}{8}$ -in. rods properly placed. The concrete was machine mixed in the proportions of 5 sand and gravel to 1 cement, wheeled in barrows an average of 125 ft. About 80 per cent. of the vertical surface was formed. (See Fig. 37.)

Account 9060.02—Pumps.

This account covers the cost of the following material and its erection in the pump house.

| | |
|--|------------|
| Two 5 by 8 Aldrich vertical triplex, single-acting pumps, 37 r.p.m. with metallic packing..... | \$1,597.91 |
| Two 10-h.p. induction motors, squirrel-cage, 3-phase, 60-cycle, 440-volt, 850-r.p.m..... | 287.22 |
| 2 auto starters | |
| 2 overload releases calibrated from 6 to 18 ampere per terminal..... | 124.36 |
| Miscellaneous..... | 26.09 |
| | <hr/> |
| | \$2,035.58 |

Account 9060.03—Inlet Piping to Sump.

This covers the cost of the following material and its installation between unloading tracks and the oil sump. (See Fig. 38.)

| | |
|---|----------|
| Six 10-in. wrought pipes 18 ft. long..... | \$85.54 |
| Six 10-in. cast-iron cells..... | 38.64 |
| Miscellaneous..... | 2.37 |
| | <hr/> |
| | \$126.55 |

Account 9060.44—Lighting.

This covers the cost of material and the labor of installing four drop lights in the pump house.

Account 9060.05—Roof Steel Work.

This covers the cost of the following material and the labor of installing it. (See Fig. 39).

1,876 lb. 10-in. I-beams
320 lb. 8-in. I-beams

Account 9060.06—Doors, Windows and Frames.

This covers the cost of the following material and the labor of installing it in the pump house. (See Fig. 41.)

| | |
|---|---------|
| 4 sash, 3 ft. by 2 ft. $6\frac{1}{2}$ in. by $1\frac{1}{2}$ in..... | \$17.79 |
| 2 sash, 3 ft. by 4 ft. by $1\frac{1}{2}$ in..... | 14.05 |
| 2 sash, 2 ft. 6 in. by 4 ft. by $1\frac{1}{2}$ in..... | 12.13 |
| Lumber for doors and all frames..... | 12.69 |
| Hardware..... | 8.36 |

Account 9060.07—Roof.

This covers the cost of the roof material as given below with the labor of placing the same. The "hyrib" was placed upon the steel of 9060.05 wired in place, covered with 2 in. of concrete, 5 sand and gravel to 1 cement, and plastered on top and bottom, with 1 part cement, 3 sand, $\frac{1}{2}$ hydrated lime. Later it was covered with P and B roofing, see 9003.52. (See Fig. 39).

| | |
|---------------------------------|----------|
| 784 ft. No. 24 "hyrib"..... | \$77.41 |
| 7 squares P and B roofing | 48.39 |
| Concrete plaster material..... | 36.86 |
| | <hr/> |
| | \$162.66 |

Account 9060.075—Ventilators.

This covers the cost of material in the making and placing of two ventilators shown in Fig. 40.

- 1 ventilator is 18 in. diameter, 40 ft. high made of No. 20 galvanized iron, using 130 ft. $\frac{1}{4}$ -in. guy wire.
- 1 ventilator is 18 in. diameter, 11 ft. high, made of No. 20 gauge galvanized iron.

Two 500,000 Gallon Oil Tanks**Account 9060.10—Wrecking and Transportation.**

This account covers the labor and material incident to taking down at Lordsburg, New Mexico, and transporting to Clifton, two 500,000-gal. oil tanks which had been in use there. The labor item is the cost of tearing down and loading these tanks. The material item is the freight on the tanks between Lordsburg and Clifton.

Account 9060.11—Excavation.

This account covers the making of a top slice to prepare the site for the foundation of the two 500,000-gal. oil tanks. It was done with plow, slips, pick and shovel and handled 150 ft.

Account 9060.12—Foundation.

This concrete was cast as two low circular walls, 1 ft. thick and 2 ft. deep, 62 ft. in diameter. It was mixed by machine, 8 parts sand and gravel to 1 cement, reinforced with two $\frac{3}{4}$ -in. rods and hauled to place 150 ft.

Account 9060.13—Erection.

This covers the erection of the two 500,000-gal. tanks, part on force account by the Kansas City Structural Steel Co. and part by the Arizona Copper Co. It likewise covers the cost of giving them one coat of paint, testing them out, and caulking. Here too are the material prices of the ventilators and gauges. The tanks were 60 ft. in diameter and 25 ft. high. (See Fig. 42.)

Account 9060.131—Roof Supports.

This account covers the cost of the material and labor of installing the same, used for supporting the sheathing over the two tanks. This material amounts to 10,000 ft. board measure for the two tanks. (See Figs. 42 and 43.)

Account 9060.132—Sheathing, Lath and Plaster.

Over the roof supports 1-in. sheathing was laid. On this No. 27 painted expanded metal lath was placed and plastered with a mixture of 1 cement to 3 sand, which was waterproofed with hydrated lime. Each tank has a cornice which ventilates by screened openings through its bottom. (See Figs. 42 and 43.)

Account 9060.14—Railroad Grading.

Along each side of the oil sump a large railroad grade was made. This account covers it.

Account 9060.15—Track Laying and Ballasting.

On the grade mentioned in 9060.14 the following track was laid. The account covers the material and labor of laying and ballasting.

| | |
|-------------------------------------|------------|
| 802 white oak ties..... | \$852.60 |
| 1 No. 9 frog..... | 158.39 |
| Miscellaneous track fastenings..... | 82.00 |
| | <hr/> |
| | \$1,092.99 |

Account 9060.16—Oil Track Bumpers.

This account covers the labor and material incident to making and putting in place two bumpers at the ends of the tracks on each side of the oil sump. The material is divided thus:

| | |
|----------------------------|---------|
| Lumber..... | \$8.52 |
| Iron bolts, nuts, etc..... | 39.40 |
| | <hr/> |
| | \$47.92 |

Account 9060.17—Bridges over Wood Pipe.

This covers four wooden bridges entirely buried in the fill over a number of wooden pipes. They were placed here to avoid the constant breaking of the pipes. The excavation and backfill are here included. (See Fig. 44.)

| | |
|-----------------|---------|
| Lumber..... | \$70.02 |
| Bolts, etc..... | 17.12 |
| | <hr/> |
| | \$87.14 |

Oil Supply Tanks for Reverberatories and Boilers**Account 9060.20—Excavation.**

This covers a deep cut for a retaining wall. It was in sand and gravel and made with pick and shovel. The material was hauled 300 ft.

Account 9060.21—Foundation.

This covers the concrete in a reinforced wall about 60 ft. long, 8 in. at top, 18 in. at bottom and 16 ft. high; $\frac{1}{2}$ -in. and $\frac{3}{4}$ -in. rods were used for reinforcing. The concrete was machine mixed 5 sand and gravel to 1 cement and wheeled 75 ft. in barrows to place. One hundred per cent. of the vertical surface was formed.

Account 9060.22—Cost and Erection.

This covers the cost of eight 163-bbl. steel oil tanks, with roofs and ventilators, erected on their foundations.

Account 9060.23—Piping.

This covers the material and labor cost for 785 ft. of piping, varying in size from 1 in. to 6 in. diameter. Here are also included the fittings and valves. The piping connects the tanks with the pumps.

Account 9060.40—Piping Excavation.

This includes all the trenching and backfilling incident to the oil lines from the 500,000-gal. oil tanks to the small 163-bbl. tanks. The trenches were 2 ft. wide and about 3 ft. deep on the average.

Account 9060.41—Pipe and Laying.

This account covers the cost of the pipe enumerated below and the labor of laying it.

| | |
|---------|---------------------------------------|
| 172 ft. | 12-in. wrought-iron pipe |
| 270 ft. | 16-in. wrought-iron pipe |
| 850 ft. | 8-in. wrought-iron pipe |
| 596 ft. | 2 $\frac{1}{2}$ in. wrought-iron pipe |

1,888 ft. total

A 16-in. line runs from oil sump to pump house, also from pump house to storage tanks. The 8-in. line runs from pump house to the 163-bbl. tanks. The 2 $\frac{1}{2}$ -in. line runs from the wilgus oil pumps to each of the reverberatories.

Account 9060.5—Heating Installation.

This account covers the material noted below and the labor required to install the same. This 2 $\frac{1}{2}$ -in. steam line is tapped off the steam line at the power house, run under ground through conduit and is packed in asbestos fiber. At the other end the pipe connects with a cast-iron oil heater.

| | |
|--|----------|
| 1 cast-iron oil heater..... | \$303.82 |
| 1 No. 33 Crane tilt trap..... | 35.91 |
| 280 ft. 8-in. conduit..... | 547.49 |
| Asbestos..... | 29.00 |
| 2 $\frac{1}{2}$ -in. pipe, fittings, etc | 151.82 |

\$1,068.04